Relationship Between Left Ventricular Ejection Fraction And Fragmented QRS Complexes On Standard 12-Lead Electrocardiogram In Acute ST-Elevation Myocardial Infarction

A Dissertation Submitted to

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI

In Partial Fulfillment of the Regulations

for the Award of the Degree of

M.D. (GENERAL MEDICINE) - BRANCH – I

GOVERNMENT KILPAUK MEDICAL COLLEGE

CHENNAI

April - 2015

BONAFIDE CERTIFICATE

This is to certify that **"Relationship between Left Ventricular Ejection Fraction and Fragmented QRS Complexes on Standard 12-Lead Electrocardiogram in Acute ST-Elevation Myocardial Infarction"** is a bonafide work performed by**Dr.SURESH KUMAR.S.**, post graduate student, Department of Internal Medicine, Kilpauk Medical College, Chennai-10, under my guidance and supervision in fulfilment of regulations of the Tamil Nadu Dr. M.G.R Medical university for the award of M.D. Degree Branch I (General Medicine).

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DECLARATION

I solemnly declare that this dissertation **"Relationship between Left Ventricular Ejection Fraction and Fragmented QRS Complexes on Standard 12-Lead Electrocardiogram in Acute ST-Elevation Myocardial Infarction"** was prepared by me at Government Kilpauk Medical College and Hospital, Chennai, under the guidance and supervision of **Dr.S.Ushalakshmi M.D.**,**FMMC.,** Professor of Internal Medicine, Government Kilpauk Medical College and Hospital, Chennai.

This dissertation is submitted to **The Tamil Nadu Dr. M.G.R. Medical University, Chennai** in partial fulfillment of the University regulations for the award of the degree of **M.D. Branch I (General Medicine)**.

Place: Chennai **Dr.SURESH KUMAR.S**
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ACKNOWLEDGEMENT

At the outset, It is with immense honor and gratitude that I thank our Dean **Prof. Dr.N.Gunasekaran M.D., D.TC.D.,** and former Dean **Prof. Dr. Ramakrishnan M.D.,D.L.O.**,for his kind permission to conduct the study in Kilpauk Medical College.

I would like to acknowledge, **Prof. Dr. R.Sabaratnavel M.D**, Professor and Head of the Department of medicine, Kilpauk Medical College and Govt.Royapettah Hospital for his supportiveness and guidance to my study work.

I would like to acknowledge, **Prof. Dr. S.Ushalakshmi,M.D., FMMC**, Unit chief for her support and guidance during the course of the study.

I would like to show my gratitude to **Prof. Dr. Nandakumaran M.D.,D.M.,**HOD of cardiology for his supportiveness and guidance to my study work.

I am very grateful to **Dr. Bathragiri, Dr. Marimuthu,** Assistant professors in department of medicine for their guidance.I am also grateful to staff members of department of medicine and department of cardiology for their support

Finally, I would like to owe a lot to my patients for their support and without them this project would not have been possible.

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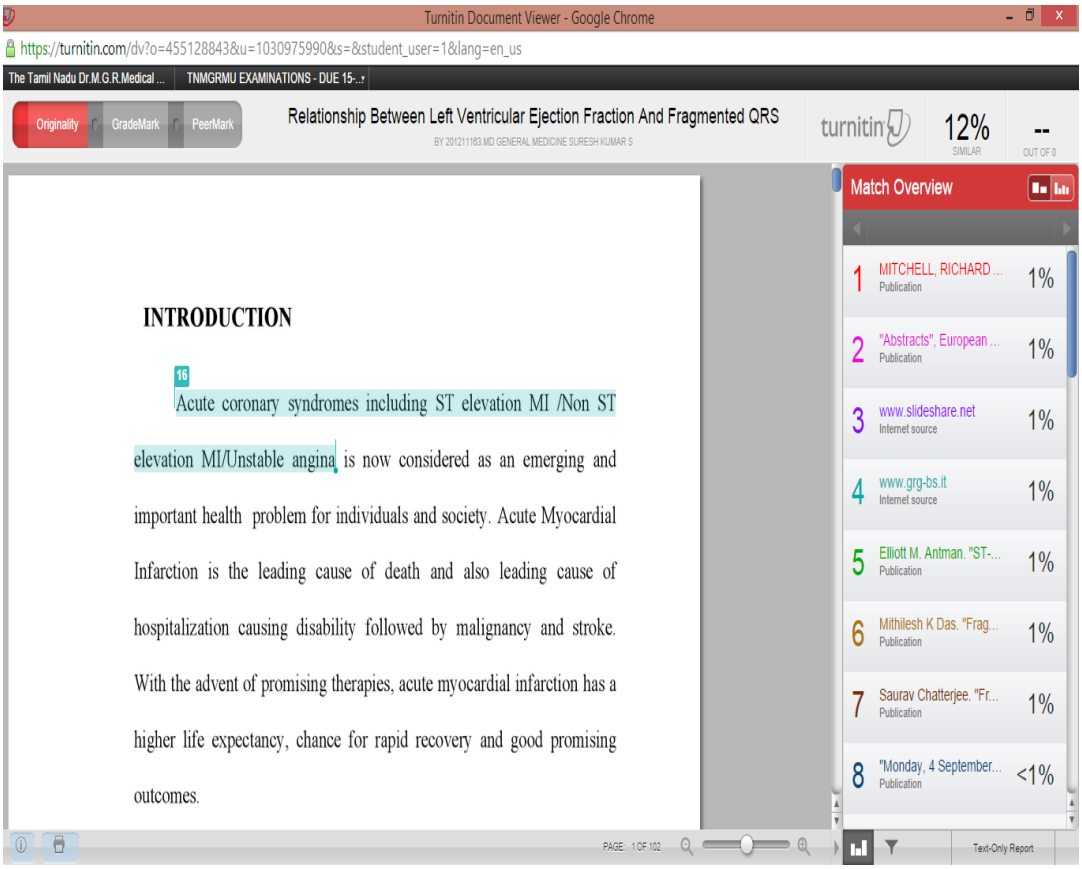
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INTRODUCTION
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Acute coronary syndromes including ST elevation MI /Non ST elevation MI/Unstable angina is now considered as an emerging and important health problem for individuals and society. Acute Myocardial Infarction is the leading cause of death and also leading cause of hospitalization causing disability followed by malignancy and stroke. With the advent of promising therapies, acute myocardial infarction has a higher life expectancy, chance for rapid recovery and good promising outcomes.
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ABSTRACT

BACKGROUND

Fragmented QRS complex in an ECG is a marker of myocardial necrosis or scarring.

OBJECTIVE

To find the relationship between fragmented QRS in an ECG in the setting of acute ST elevation myocardial infarction and left ventricular ejection fraction.

MATERIALS AND METHODS

Consecutive patients with acute ST elevation MI admitted in the intensive coronary care unit will be included in the study. The data of each patient is collected in a specifically prepared proforma and includes relevant medical history, ECG findings on admission and serial ECGs, and Ejection fraction assessed by Echocardiogram within 48 hours of onset of symptoms. Patients with fQRS in the ECG were taken as cases and patients without fQRS. Using statistical methods ejection fraction between the two groups was analysed.

RESULTS

Analysis showed that the mean ejection fraction of the cases group is 40.95 %.Mean ejection fraction of the control group is 54.06 %. p value is < 0.001**.So there is significant statistical relationship between the presence of fragmented QRS and the ejection fraction.

CONCLUSION

There is an significant association between presence of fragmented QRS and the ejection fraction in the setting acute ST elevation myocardial infarction. Presence of fQRS indicates myocardial necrosis and hence lower ejection fraction when compared with controls. Hence fQRS indicates severity and poorer prognosis.

KEYWORDS: FRAGMENTED QRS, EJECTION FRACTION.

INTRODUCTION

Acute coronary syndromes including ST elevation MI /Non ST elevation MI/Unstable angina is now considered as an emerging and important health problem for individuals and society. Acute Myocardial Infarction is the leading cause of death and also leading cause of hospitalization causing disability followed by malignancy and stroke. With the advent of promising therapies, acute myocardial infarction has a higher life expectancy, chance for rapid recovery and good promising outcomes.

Despite new therapies, poor outcome may still occur because Acute Coronary Syndrome is a heterogeneous disease in which outcome is influenced by many causative factors. The extent of myocardial injury and the resultant outcome from ischemia is largely dependent upon the physiological level by the severity and duration of the ischemia.

The risk factors namelysmoking, diabetes, dyslipidemia, blood pressure (BP) and alcohol predict the happening of acute coronary syndromes. Post ACS individual, way of living depends upon the area of the involved myocardium and the secondary prevention of recurrent cardiovascular events.

Notching of QRS complex is poorly understood and are under estimated finding in an electrocardiogram. Various studies have shown the relation between the fragmented QRS in an ECG following acute coronary syndromes and mortality and morbidity post ACS. In this study the relation between the presence and absence of fragmented QRS and the left ventricular ejection fraction ,following an acute ST elevation myocardial infarction is studied .

REVIEW OF LITERATURE

EPIDEMIOLOGY OF CADIN INDIA

Coronary artery disease is the leading cause of death emerging in India and worldwide.It was thought previously that it is more prevalent in developed countries but it now leads to more mortality in developing countries like India.The rates are increasing disproportionately when compared to developed countries.It has a greater impact on a countries socio economic development[1].

PREVALENCE OF CAD INDIA [2007 ESTIMATES]

FIGURE SHOWING URBAN PREVALENCE OF CAD.

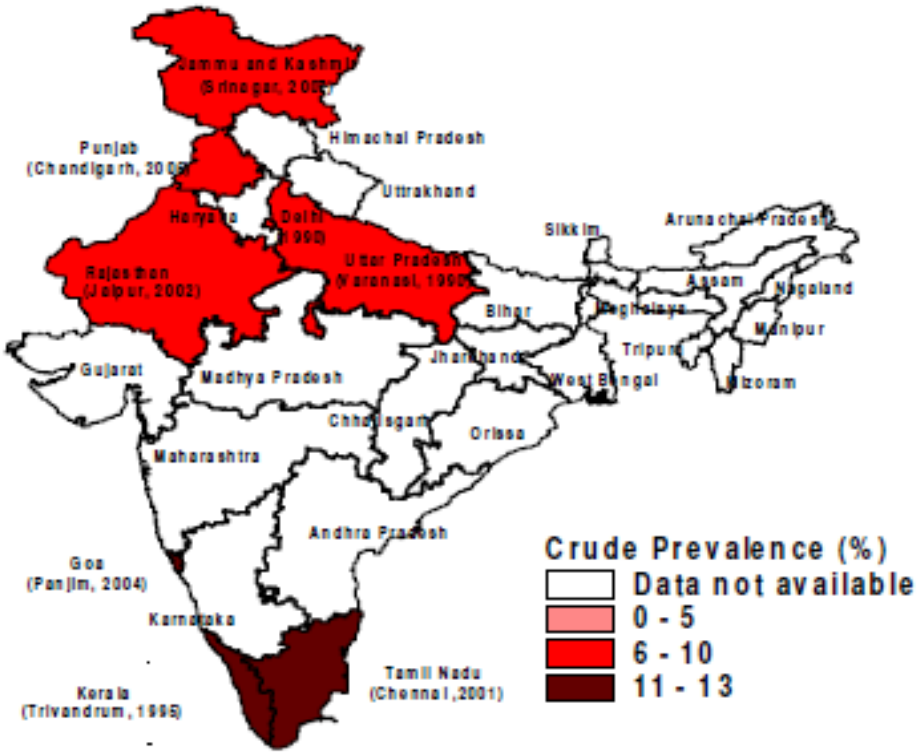


FIGURE SHOWING RURAL PREVALENCE OF CAD

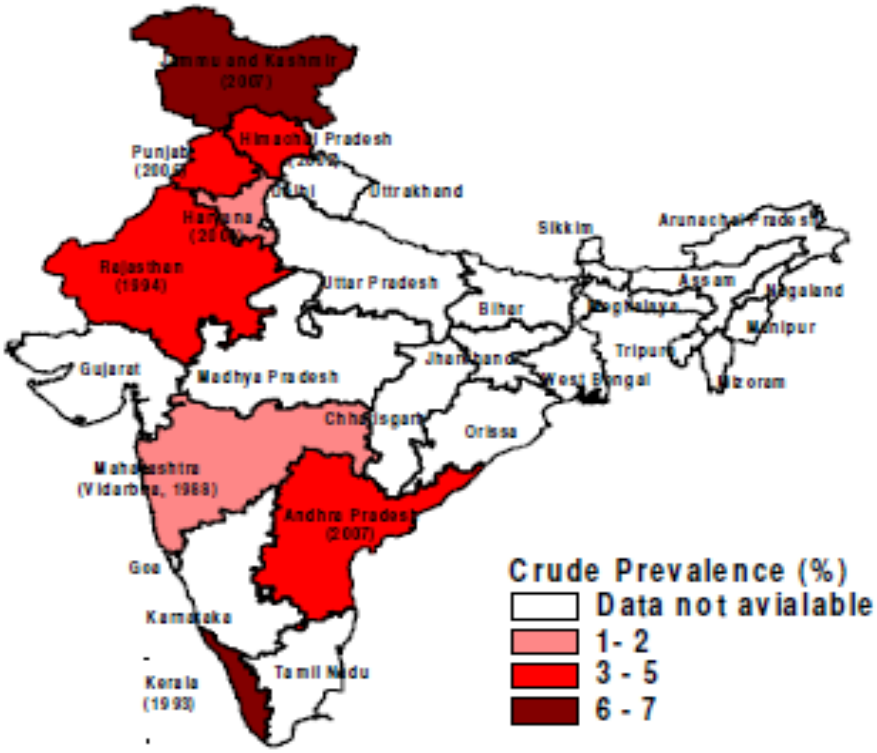


TABLE SHOWING BURDEN OF CAD IN WORLD AND INDIA

Mortality Associated with CHD

Global CHD Mortality

In 2004, CHD was the leading cause of death worldwide, leading to:

- 7.2 million deaths (12.2% out of a total of 58.8 million deaths)
- 134.0 deaths per 100,000
- 138.6 age-standardized deaths per 100,000
- 22,370,000 DALYs (disability adjusted life-year)
- 222,762 age-adjusted DALYs per 100,000

CHD Mortality in India

In 2004, CHD was the leading cause of death in India, leading to:

- 1.46 million deaths (14% out of a total of 10.3 million deaths)
- 130.7 deaths per 100,000
- 207.7 age-standardized deaths per 100,000
- 15,588,000 DALYs
- 1,931 age-adjusted DALYs per 100,000

(WHO, 2004; WHO, 2009)

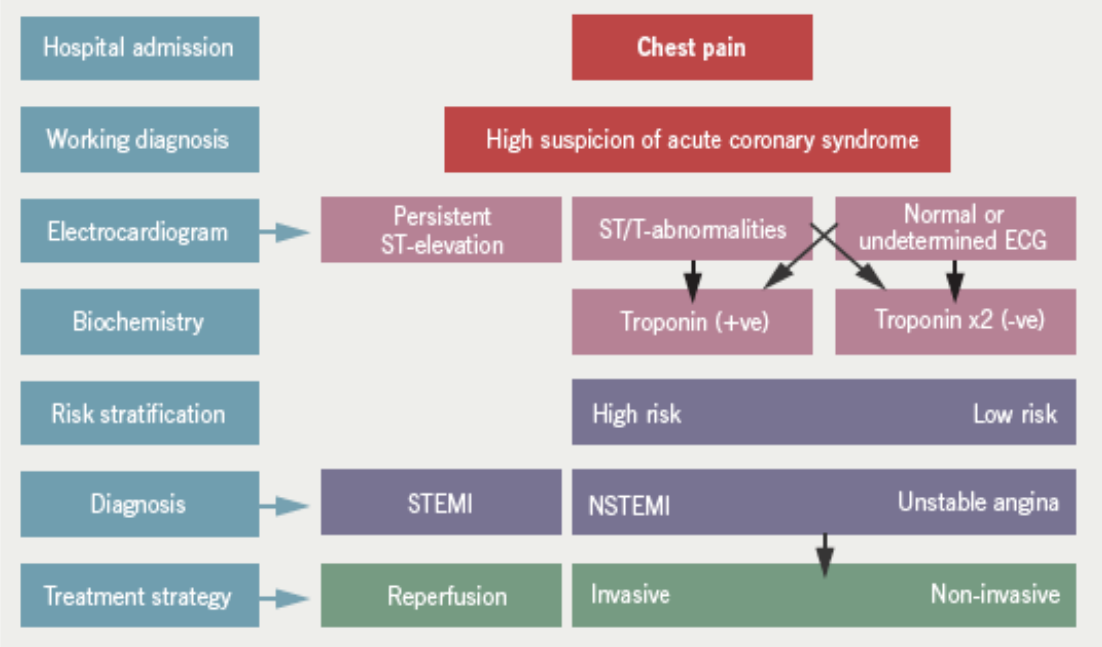
ACUTE CORONARY SYNDROMES

Spectrum of acute coronary syndromes include

1)UNSTABLE ANGINA

2)NON ST ELEVATION MI

3)ST ELEVATION MI



Stable angina is characterised by chest pain or discomfort associated with physical exertion, which is relieved by rest or nitrates within 5 to 10 minutes.

Unstable angina is defined as anginal pain atleast with 1 out of 3 features

1) Pain even at rest or with minimal exertion,lasting>10 minutes

2) New onset and severe (within prior 4-6 weeks)

3) Crescendo pattern

NSTEMI is diagnosed if patients have clinical features of unstable angina with elevated cardiac biomarkers.

In STEMI patient presents with typical anginal pain and has ST elevation in 12 lead ECG and raised cardiac biomarkers[(2)].

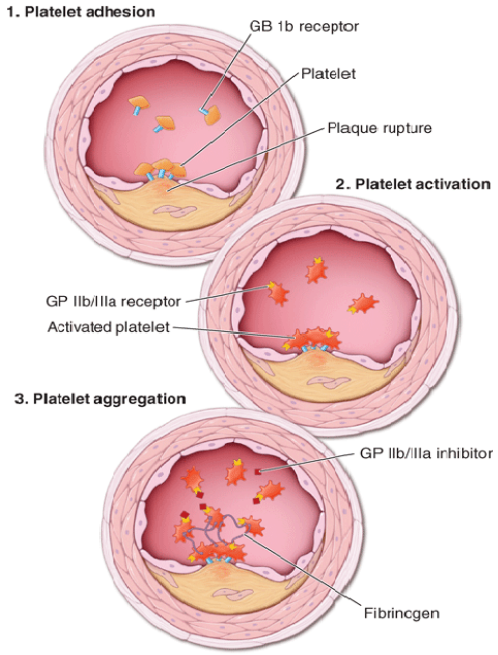
PATHOPHYSIOLOGY OF ACUTE CORONARY SYNDROMES

The evolution of ACS has been shown to involve two distinct processes

1) a fixed, irreversible process involving gradual narrowing of lumen(atherosclerosis)

2) a dynamic, reversible process, in which there is slow progression to sudden and rapid coronary occlusion(thrombosis).

FIGURE: PROCESS OF THROMBUS FORMATION INVOLVING PLATELET ADHESION, ACTIVATION AND AGGREGATION



In many situations atherosclerosis predominates in chronic stable angina and thrombosis predominates in ACS[3]. Hence the term atherothrombosis is used frequently.

ATHEROSCLEROSIS

Endothelial dysfunction is the initial triggering part of atherosclerosis.Endothelial dysfunction or injury triggers various cytokine,growth factors,hydrolytic enzymes with focal vessel wall necrosis and tissue repair and fibrosis ,simultaneously.

The next stage is the formation of fibrofatty plaque.The plaque consists of a raised lesion with soft,yellow core which consist of lipid (cholesterol and its esters) and covered by a firm, white fibrous cap[4]. This cause obstruction to blood flow, and also weaken the underlying media and when it ruptures, causes acute thrombosis of the vascular lumen.

PLAQUE STABILTY

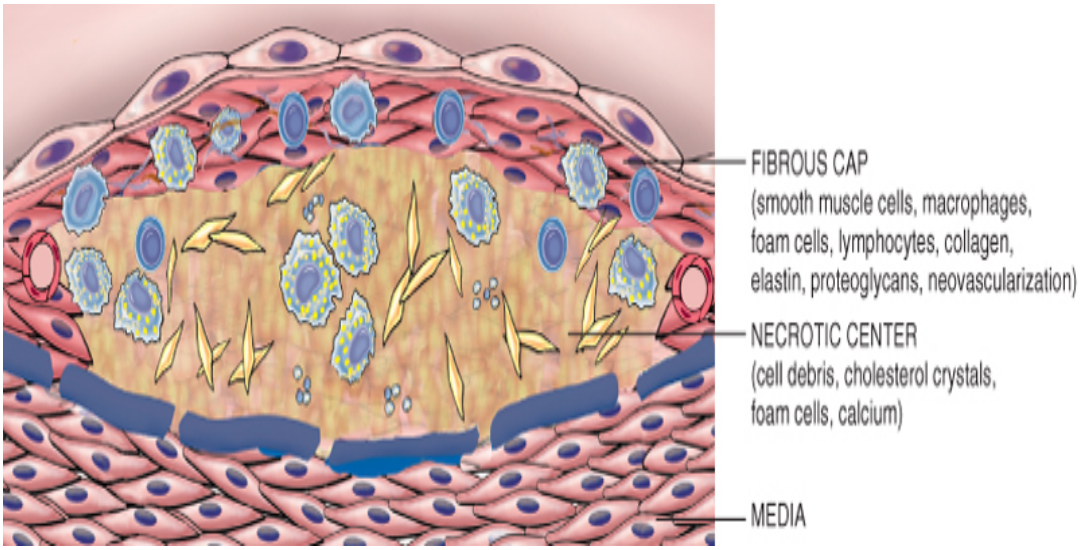
It is dependent on three factors:

A) Mechanical stress acting on fibrous cap

B) Factors causing weakening of the cap

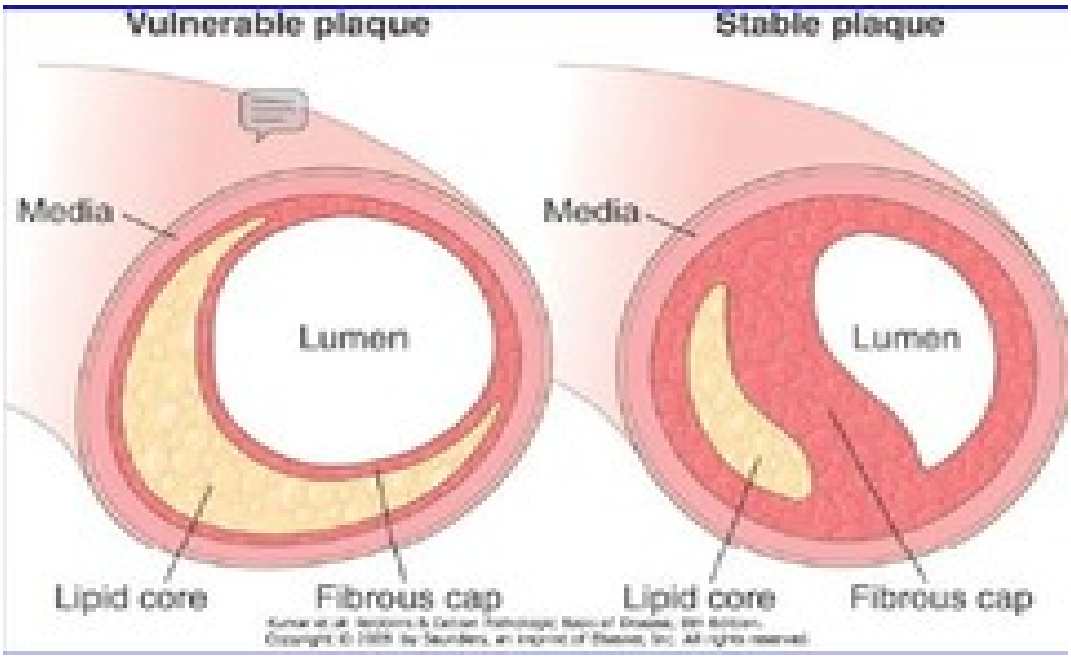
C) Inflammatory triggers.

FIGURE : PLAQUE STABILITY



A plaque becomes ‘unstable’ or ‘vulnerable’ when the balance between the production and destruction[5] of interstitial collagen,is disrupted.

FIGURE: PLAQUE STABILITY



RISK FACTORS FOR ATHEROSCLEROSIS

TABLE: MAJOR RISKS FACTORS

Major Risks	Lesser, Uncertain, or Nonquantitated Risks
Nonmodifiable	Obsesity
Increasing age	Physical inactivity
Male gender	Stress ("type A personality)
Family history	Postmenopausal estrogen deficiency
Genetic abnormalities	High carbohydrate intake
	Lipoprotein(a)
Potentially Controllable	Hardened (trans)unsaturated fat intake
Hyperlipidemia	
Hypertension	*Chlamydia pneumoniae infection*
Cigarette smoking	
Diabetes	
C-reactive protein	

NON MODIFIABLE RISK FACTORS

Age

It has a greater influence in the pathogenesis of atherosclerosis. The accumulation of atherosclerotic plaque is a gradual process, it does not clinically manifest until it reaches a critical threshold.The incidence of myocardial infarction in men increases by five times by the age of 40-60, even though the underlying lesions were evolving before that.

Gender

After menopausal age, the incidence of atherosclerosis-related diseases in women is more than that of men. Premenopausal women are protected against atherosclerosis and its complications if compared to men of same age. This is explained by favourable influence of oestrogen on atherosclerotic process[6].This explains why complications of atherosclerosis like MI and stroke are uncommon in premenopausal women unless they have other risk factorslike dyslipidemia,systemic hypertension or diabetes.

Genetic factors

The familial tendency for atherosclerosis and coronary artery disease is a well-known fact and it is influenced by several factors. In few instances it is due to presence of other risk factors like systemic hypertension or diabetes in the same family[7].Whereas in others it involves a well-defined genetic derangements in lipid metabolism, such as familial hypercholesterolemia.

MODIFIABLE RISK FACTORS

Hyperlipidemia

This is a well-known major risk factor for atherosclerosis.Even in the absence of other risk factors, dyslipidemia by itself can cause atherosclerosis development[8]. The most important lipid component in blood associated with coronary artery disease is lowdensity lipoprotein (LDL) cholesterol .Its major function is to deliver cholesterol to peripheral tissue. In contrast, highdensity lipoprotein [HDL] mobilizes cholesterol from atheromas and transports it to the liver after which it is excreted into the bile. Hence higher is the serum HDLlevel, lesser is the cardiovascular risk.

Diet and pharmacotherapy which lower LDL or and raise serum HDL are all of high interest. Increased intake of animal fats,butter and egg raises serum cholesterol levels. On the other hand diets low in cholesterol and with higher ratios of PUFA (polyunsaturated fatty acids) lowers plasma cholesterol levels. Omega-3 fatty acids are beneficial[9], whereas unsaturated fats which are produced by hydrogenation of polyunsaturated oils produce an negative impact on cholesterol profiles.Aerobic exercises and moderate intake of alcohol raise HDL levels, whereas obesity and smoking decreases it.

HYPERTENSION

Another major important risk factor which is associated atherosclerosis is hypertension; systolic and diastolic blood pressures are equally important. Coronary artery disease risk increases by approximately60% in hypertensive patients when compared to populations with normal blood pressure. When hypertensive patient is not treated approximately half of patients will die of CAD or congestive cardiac failure, and another third will die with the development of stroke.

CIGARETTE SMOKING

Cigarette smoking is associated with increased risk in both sexes. Daily smoking of more than 1 pack of cigarettes increases the death rate from CAD by 200%. When it is stopped the risk is reduceddramatically[(10)].

DIABETES MELLITUS

Diabetes acceleratesdyslipidaemia and atherosclerosis occurs more frequently. The risk of acquiring acute myocardial infarction is twice in diabetics as compared to nondiabetics.

ATHEROSCLEROSIS OF CORONARY ARTERIES

Atherosclerotic activity occurs mainly in large vessels like epicardial coronary artery. The factors associated with atherosclerosis viz. increased plasma low density lipoprotein(LDL) , decreased serum highdensity lipoprotein(HDL), smoking,systemic hypertension, and diabetes mellitus interferes with the functions of the vascular lumen endothelium which include a)control of local vessel tone b)maintaining antithrombotic state over the surfaceand c) control of inflammatory cell adhesion and diapedesis[11].

When these properties are impaired it results in pathologic occlusion, thrombus formation, and abnormal interactions among blood cells(WBC,RBC,PLATLETS), most importantly between macrophages and platelets and the activated luminal endothelial cells. These are the functional changes and they lead to the subintimal collections of lipids, intercellular matrix, smooth muscle cells and fibroblasts that result in the formation of atheroma.

There is an increased tendency for atherosclerotic plaques to form at sites where there is increased turbulent flow in coronary arteries, commonly at branchingpoints in the epicardialarteries[12].

When luminal diameter is reduced to50% of an epicardial arterydiameter, ability to increase coronary flow is limited when myocardial demand is more. When the diameter is reduced by

80%approximately,even during period of rest, blood flow may be reduced , and further small decreasein the stenosed vessel orifice area can decrease coronary flow markedly and cause myocardial infarction or ischemia at rest or only with minimal exercise.

Narrowing of epicardial coronary artery by atherosclerosis in most of case is caused by the formation of a plaque, which can leads to rupture or erosion of the cap and this separates plaque from the bloodstream.

When plaque contents is exposed two important and related processes occurs: (a) platelets activation and aggregation, and (b) the coagulation process is activated, which results in deposition of fibrin strands · The thrombus consist mainly platelet aggregates and fibrin strands along with red blood cells and it can reduce coronary blood flow, resulting in the clinical manifestations of myocardial ischemia.

The thrombuslocation determines the quantity of myocardial cells that become ischemic and play a main role indetermining the severity of the clinical features[13]. So, critical obstructions narrowing diameter of maincoronary vessels, such as the left main coronary artery(LMCA) and the proximal portion of left anterior descending (LAD) coronary artery, are associated with poorer outcomes[14]. Chronic severe narrowing of coronary vessel leading to myocardial ischemia ultimately result in the

development of collateral blood vessels, particularly when there is gradual development ofnarrowing . When collaterals arewell developed, they alone can provide sufficient amount of blood flow and sustain the viability of the myocardium at rest but not during time of increased demand like exercise .

HISTORY AND CLINICAL PRESENTATION

Pain in the left retrosternal region or discomfort in the epigastric region are the most common presentationin patient with acute coronary syndrome, and frequently radiates to the neck, left shoulder,right shoulder, back but more commonly to the left shoulder and arm. Thisdiscomfort is usually very severe, compressing nature and may be experienced as frank pain.

“Anginal equivalents" are the features other than chest pain in a patient with CAD can present,such as breathlessness and discomfort in epigastric region, and these occur more frequently in females and diabetics[15].The physical examination is very similar to that seen in patients with stable angina and sometimes not well prominentat all. If the patient is affected by severe myocardial ischemiaor extensive UA/NSTEMI, the clinical features like diaphoresis, pale and cold peripheries, tachycardia, gallop rhythm, pulmonary crepitations and shock, similar to the features seen in patients with ST elevation can be seen .

While evaluation of patients with suspected STEMI/UA/NSTEMI is made ,one should keep in mind ,whether the chest discomfort of being caused by myocardial ischemia can be in one of three categories: high, intermediate, or low likelihood[16].

TABLE : CATEGORIES OF MYOCARDIAL ISCHEMIA

High Likelihood
Known coronary disease (particularly recent percutaneous coronary intervention)
Typical angina reproducing prior documented angina
Hemodynamic or ECG changes during pain
Variant angina
ST-segment elevation or depression of at least 0.5 mm
Marked symmetric T-wave inversion in multiple precordial leads
Elevated cardiac enzymes
Intermediate Likelihood
Absence of high-likelihood features and any of the following:
Typical angina in a patient without prior documented angina
Atypical anginal symptoms in diabetics or in nondiabetics with two or more other risk factors
Male gender
Age >70
Extracardiac vascular disease
T-wave inversion of at least 1 mm in leads with dominant R waves
Low Likelihood
Absence of high- or intermediate-likelihood features but may have:
Chest pain, probably not angina
One risk factor but not diabetes
T waves flat or inverted <1 mm in leads with dominant R waves
Normal ECG

TABLE: KILLIP'SCLASSIFICATION OF PATIENTS WITH ACUTE MI.

Killip class	Hospital mortality (%)
I No congestive heart failure	6
II Mild congestive heart failure, rales, S_3, congestion on chest radiograph	17
III Pulmonary edema	38
IV Cardiogenic shock	81[a]

ELECTROCARDIOGRAPHY

The presence or absence of MI and prognostication can be done by a simple 12 lead ECG.A first ECG within 10 minutes of arrival to the casualty is the protocol. ECG changes in T-wave are sensitive for myocardial ischemia but are specific, only when they are new, deeper and magnitude of T wave inversions ≥ 0.3millivolt.Continuous ECG monitoring is recommended as periodic ECG may not accurately reflect the dynamicity[17].

STEMI is defined by ST segment elevation greater than 2mm in 2 or more contiguous precordial leads or more than 1mm in 2 or more contiguous limb leadsor new onset left bundle branch block.

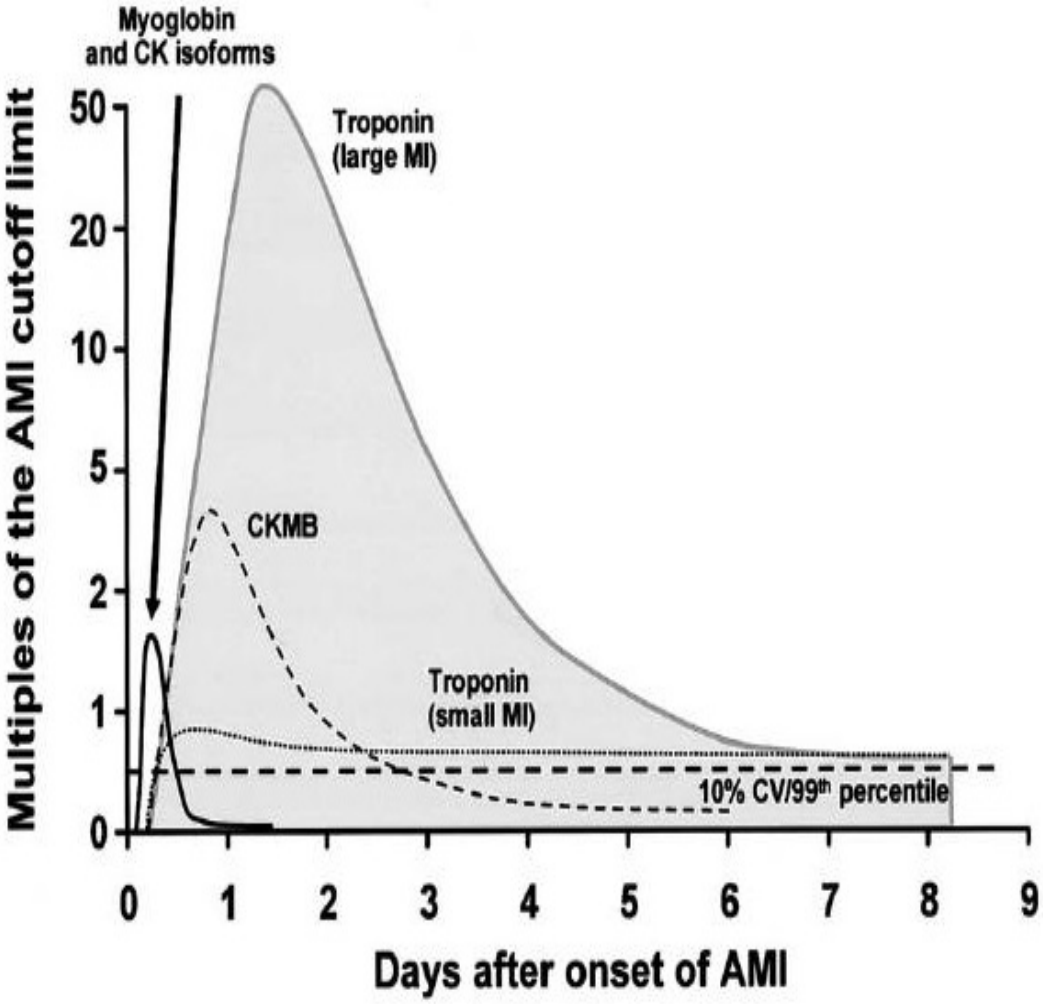
TABLE : LOCALISATION OF MI AND ITS SPECIFIC COMPLICATION

ST Elevations	Affected Coronary Artery	Area of Damage	Complications
V_1 through V_4	Left coronary artery: Left anterior descending	Anterolateral heart wall Septum Left ventricle His bundle Bundle branches	Left ventricular dysfunction: Decreased carbon dioxide, congestive heart failure Left bundle-branch block Right bundle-branch block Left posterior fascicular block Infranodal block (2° or 3°)
V_5 through V_6, I, aVL	Left coronary artery: Left circumflex branch	Left lateral heart wall	Left ventricular dysfunction: Decreased carbon dioxide, congestive heart failure Infranodal block (2° or 3°)
II, III, aVF, V_4R	Right coronary artery: Posterior descending branch	Inferior heart wall Right ventricle	Hypotension (particularly with nitroglycerin and morphine, which can decrease preload) Supranodal 1° heart block Atrial fibrillation/flutter, premature atrial contractions Infranodal block (2° and 3°) Papillary muscle rupture (murmur)
V_8 and V_9 (or ST depressions in V_1 and V_2)	90% Right coronary artery: Posterior descending branch 10% Left coronary artery: Left circumflex branch (will see elevations in V_5 through V_6)	Posterior heart wall	Hypotension Supranodal 1° heart block Infranodal block (2° and 3°) Atrial fibrillation/flutter, premature atrial contractions Papillary muscle rupture (murmur)

CARDIAC BIOMARKERS

The first cardiac biomarker identified was SGOT or AST.Soon LDH and CK MB came into light.Patients who has unstableangina/NSTEMI and have elevated cardiac enzymes indicating myocardial necrosis, such as Troponin and CPK-MB , and are at increased risk for death or recurrent MI[18]. When levels of these cardiac bio markers increase it helps to differentiate patients with NSTEMI and UA.

More is the level of troponin more is the increase and death rate.False positive minor elevations in troponins have been seen in patients without myocardial necrosis and is be due to congestive heart failure, myocarditis,chronic kidney disease and pulmonary embolism[19]. Thus, in patients without a significant history, mild elevations in troponin cant be used for diagnosis of myocardial necrosis.


Myoglobin
and CK isoforms
Troponin
(large MI)
CKMB
Troponin
(small MI)
10% CV/99th percentile
Multiples of the AMI cutoff limit
50
20
10
5
2
1
0
0
1
2
3
4
5
6
7
8
9
Days after onset of AMI

ECHOCARDIOGRAPHY

This is the most popular and widely available modality for cardiac imaging. Myocardial necrosis results in left ventricular regional wall motion abnormalities(RWMA)[20].This precedes both symptoms and ECG findings.It can't distinguish between RWMA of an old infarction and RWMA of acute MI.LV systolic and diastolic function can be assessed, which is a prognosis determinant.

MYOCARDIAL PERFUSION IMAGING

Lack of blood flow to the affected region can be identified by nuclear perfusion scan[21]. It can't differentiate from an old infarction. Imaging during rest and stress is a standard procedure.

CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY

Coronary computed tomography angiography (CCTA) is a powerful tool emerging for patients with suspected ACS. Imaging can be done in less than 10-15 seconds[22].

CARDIOVASCULAR MAGNETIC RESONANCE IMAGING

CMR has the capacity to assess perfusion,viability and cardiac function in the same setting.Late gadolinium enhancement allows for assessment of viable myocardium and infarction/scar.

STEMI is diagnosed if patient has any two of the following.

A].Patient with ischemic discomfort

B]. ST elevation in electrocardiogram

C]. Rise in serum biomarker.

DIFFERENTIAL DIAGNOSIS

For patients having acute onset chest pain, consider the following differential diagnosis

• Hypertensive urgency or emergency

• GERD

• Pericarditis

• Myocarditis

• Pulmonary embolism

• Oesophageal rupture or spasm

• Aortic dissection

• Pneumothorax

• Costochondritis

ORAL ANTI PLATELET THERAPY

ASPIRIN

It forms the main component in the treatment of patients with unstable angina/NSTEMI.It irreversibly inhibits thromboxane A2 by inhibiting cyclooxygenase enzyme.The common loading dose is150- 365 mg. Low doses (75–150 mg/d) is given for long-term therapy. "Aspirin resistance" is encountered in5 to 10% percent of patients[23]. It might result from inadequate dose, non compliance and poor absorption or rapid metabolism.

CLOPIDOGREL AND TICLOPIDINE

Both are ADP antagonists and belong to thienopyridine group .They reduce blood viscosity by increasing bleeding time.Clopidogrelis an inactive prodrug,converted into an active metabolite.When used in combination with aspirin,it was shown to provide a significant reduction in death due to MI, stroke and cardiovascular events, compared with aspirin alone[24]. This effect is seen in both low and high risk patients. Disadvantage of this combination is a moderate but absolute one percent increase in significant bleeding episode[25].Loading dose of clopidogrel given is 600mg orally ,which is followed by 75 mg per day orally.

NEWER ANTIPLATELET DRUGS

Prasugrel, ticagrelor, cangrelor are newly available antiplatelet drugs.Prasugrel has more faster antiplatelet effect and profound action than clopidogrel.It achieves higher levels of platelet inhibition.Ticagrelor is a reversible inhibitor of p2y12 receptor[26].PLATO trial compared efficacy of clopidogrel and ticagrelor.The main adverse effects are ventricular pauses and dyspnoea.

GP llb/llla INHIBITORS

They act by occupying llb/llla receptors on the surface of the platelets that are activated.Prevents formation of cross linking platelets from fibrinogen.Three drugs approved are abciximab,tirofiban and eptifibatide.

ANTICOAGULANTS

UNFRACTIONATED HEPARIN

It is a time tested drug mainly used in unstable angina.One of the main challenge associated with heparin therapy is target level of anticoagulation.Activated partial thromboplastin (aPTT) is frequently monitored.Heparin induced thrombocytopenia (HIT) is one of the life threatening complication associated.It is due to formation of platelet 4

and heparin complex and results in disseminated intravascular coagulation(DIC).Lepirudin,argotroban and fondaparinux is used in treatment.

LOW MOLECULAR WEIGHT HEPARIN

Close monitoring as like with unfractionated heparin is not required in low molecular weight heparin.There is low incidence of HIT and bleeding complications[27].

DOSAGE;

Enoxaparin-1 mg/kg SC q12h

Dalteparin-120iu/kg SC q12h

GFR-10 to 50 ml/min:usual dosage

GFR-<10 ml/min:50 % of usual dosage.

FONDAPARINUX

It is a synthetic pentasaccharide ,specific inhibitor of factor Xa.It allows a fixed dosage, simple, once a day regimen of subcutaneous route.

DIRECT THROMBIN INHIBITORS

Bivalirudin is a direct thrombin inhibitor which has equal potency to either unfractionated heparin or low molecular weight heparin, has less bleeding when bivalirudin alone is used it when compared to the combination of UFH/LMWH and a GP IIb/IIIa antagonist in patients with unstable angina and non ST elevation MI undergoing catheterization andPCI[28].

TABLE : ANTIPLATELETS AND ANTITHROMBOTIC AGENTS OVERVIEW

Oral Antiplatelet Therapy	
Aspirin	Initial dose of 162–325 mg nonenteric formulation followed by 75–162 mg/d of an enteric or a nonenteric formulation
Clopidogrel	Loading dose of 300-600 mg followed by 75 mg/d
Prasugrel	Pre-PCI: Loading dose 60 mg followed by 10 mg/d
Intravenous Antiplatelet Therapy	
Abciximab	0.25 mg/kg bolus followed by infusion of 0.125 µg/kg per min (maximum 10 µg/min) for 12 to 24 h
Eptifibatide	180 µg/kg bolus followed by infusion of 2.0 µg/kg per min for 72 to 96 h
Tirofiban	0.4 µg/kg per min for 30 min followed by infusion of 0.1 µg/kg per min for 48 to 96 h
Heparins*	
Unfractionated Heparin (UFH)	Bolus 60–70 U/kg (maximum 5000 U) IV followed by infusion of 12–15 U/kg per h (initial maximum 1000 U/h) titrated to a PTT 50–70 s
Enoxaparin	1 mg/kg SC every 12 h; the first dose may be preceded by a 30-mg IV bolus; renal adjustment to 1 mg/kg once daily if creatine Cl < 30 cc/min
Fondaparinux	2.5 mg SC qd
Bivalirudin	Initial bolus intravenous bolus of 0.1 mg/kg and an infusion of 0.25 mg/kg per hour. Before PCI, an additional intravenous bolus of 0.5 mg/kg was administered, and the infusion was increased to 1.75 mg/kg per hour.

NITRATES

This is the main stay of treatment for angina.Nitrates are converted to nitric oxide to cause vasodilatatation of capacitance vessels.This results in decreased venous return(preload) and reduction in afterload.So there is a reduced myocardial O2 demand and stress.Nitrates can be administered by sublingual route (0.3–0.6 mg)or it is given by buccalspray in patient experiencing chestpain[29]. If patient have pain even after giving 3 doses given 5 minutes apart, intravenous NTG [5–10 microgram/min] should be given. The rate of the infusion may be adjusted by increasing 10 microgram/min every 3 to 5 minutes till symptoms subsides or systolic blood pressure becomes less than 100 mmHg.Common side effects include hypotension and headache.Absolute contraindication for using nitrates are hypotension and use of sildenafil group drugs in the previous one or two days[30].

BETA BLOCKERS

Oral beta blockers comes under class l recommendation and should be initiated within 24 hours of admission.They act by inhibiting beta l adrenergic receptors.It decreases myocardial contractility,AV nodal Conduction and sinus nodal rate[31].It increases the duration of diastole,thereby increasing coronary blood flow.Target heart rate maintained is 50 to 60 bpm.Contraindications for its use are sinus bradycardia(<50 bpm),any second degree ,third degree block,hypotension,history of asthma/COPD.

CALCIUM CHANNEL BLOCKERS

They act by causing coronary vasodilation,decreasing heart rate,decreasing myocardial contractility.Drugs like diltiazem and others in calcium channel blockers group are used in patients who are not relieved of symptoms despite treatment with maximum dose ofbeta blockers and nitrates and in patient whom beta blocker cannot be used due to contraindications like asthma[32].It is also used in prinzmetal angina.Nifedipine is harmful in acute MI.

NEWER ANTI-ISCHEMIC THERAPIES

Ranolazine,nicorandil,ivabradine,trimetazidine.

TABLE :

Drug Category	Clinical Condition	When to Avoid[a]	Dosage
Nitrates	Administer sublingually, and, if symptoms persist, intravenously	Hypotension Patient receiving sildenafil or other PDE-5 inhibitor	Topical, oral, or buccal nitrates are acceptable alternatives for patients without ongoing or refractory symptoms 5–10 μg/min by continuous infusion titrated up to 75–100 μg/min until relief of symptoms or limiting side effects (headache or hypotension with a systolic blood pressure <90 mmHg or more than 30% below starting mean arterial pressure levels if significant hypertension is present)
Beta blockers[b]	Unstable angina	PR interval (ECG) >0.24 s 2° or 3° atrioventricular block Heart rate <60 beats/min Systolic pressure <90 mmHg Shock Left ventricular failure Severe reactive airway disease	Metoprolol 25–50 mg by mouth every 6 h If needed, and no heart failure, 5-mg increments by slow (over 1–2 min) IV administration
Calcium channel blockers	Patients whose symptoms are not relieved by adequate doses of nitrates and beta blockers, or in patients unable to tolerate adequate doses of one or both of these agents, or in patients with variant angina	Pulmonary edema Evidence of left ventricular dysfunction (for diltiazem or verapamil)	Dependent on specific agent
Morphine sulfate	Patients whose symptoms are not relieved after three serial sublingual nitroglycerin tablets or whose symptoms recur with adequate anti-ischemic therapy	Hypotension Respiratory depression Confusion Obtundation	2–5 mg IV dose May be repeated every 5–30 min as needed to relieve symptoms and maintain patient comfort

THROMBOLYSIS

It is an effective therapy in STEMI and should be given within 3 to 6 hrs of onset of chest pain for its maximal effect .

Class I

1. In the absence of any contraindications, fibrinolytic drug can be given to ST elevation MI patients with onset of symptoms within the previous 12 hours and has a ST elevation > than 0.1 mV in at least two contiguous precordial leads or at least two adjacent limb leads[33]. (Level of Evidence: A)

2. Thrombolytic therapy is also indicated in ST elevation MI patients with onset of symptoms within the prior 12 hours of admission and presumably new or new onset LBBB. (Level of Evidence: A)

Class IIa

1. When there is no any of the contraindication it is reasonable to administer thrombolytic therapy to STEMI patients with onset of symptoms within the prior 12 hours of admission and ECG shows true posterior MI[34]. [Level of Evidence: C]

2. When there is no contraindications, it is justifiable to use thrombolytictherapy to patients who has symptoms of ST elevation MI beginning within the previous 12 to 24 hours who have persistent ischemic symptoms and ST elevation >0.1 millivolt in at least two continuous precordial leads or in two adjacent limb leads[35]. [Level of Evidence: B]

Class III

1. Fibrinolytic therapy is not used in asymptomatic patients whose symptoms of ST elevation MI started more than 24 hours earlier[36]. [Level of Evidence: C]

2. Fibrinolytic therapy is not used in patients whose ECG shows except if a posterior wall MI is suspected ST-segment depression or ST depression with ST elevation in lead avR[37]. [Level of Evidence;A]

TABLE: CONTRAINDICATION OF THROMBOLYTIC AGENTS

Absolute Contraindications
Any prior intracranial hemorrhage
Known structural cerebral vascular lesion
Known intracranial neoplasm
Ischemic stroke within the past 3 months (except for acute stroke within 3 hours)
Suspected aortic dissection
Active bleeding or bleeding diathesis (excluding menses)
Significant closed-head or facial trauma within 3 months
Relative Contraindications
History of chronic, severe, poorly controlled hypertension
Systolic pressure >180 mmHg or diastolic 110 mmHg
History of prior ischemic stroke >3 months previously, dementia, or known intracranial pathology not covered in absolute contraindications
Recent (within 2 to 4 weeks) internal bleeding
Noncompressible vascular punctures
Pregnancy
Active peptic ulcer
Current use of anticoagulants: the higher the international normalized ratio, the higher the risk of bleeding
For streptokinase/anistreplase: prior exposure (more than 5 days previously) or prior allergic reaction to these agents

TABLE: FIBRIN SPECIFIC THROMBOLYTIC AGENTS

Characteristic	Alteplase (tPA)	Reteplase (rPA)	Tenecteplase (tPA)	Lanoteplase (nPA)
Immunogenicity	No	No	No	?
Plasminogen activation	Direct	Direct	Direct	Direct
Fibrin specificity	++	+	+++	+
Plasma half-life	4 to 6 min	18 min	20 min	37 min
Dose	15-mg bolus plus 90-min infusion up to 85 mg	10+10-MU double bolus 30 min apart	± 0.5 mg/kg single bolus	120 KU/kg single bolus

INVASIVE STRATEGIES

PERCUTANEOUS CORONARY INTERVENTION

Percutaneous coronary intervention in a setting of ST elevation of MI can be done by following conditions:

-Primary PCI

-Rescue PCI

-Facilitated PCI

-Early PCI

-Delayed PCI

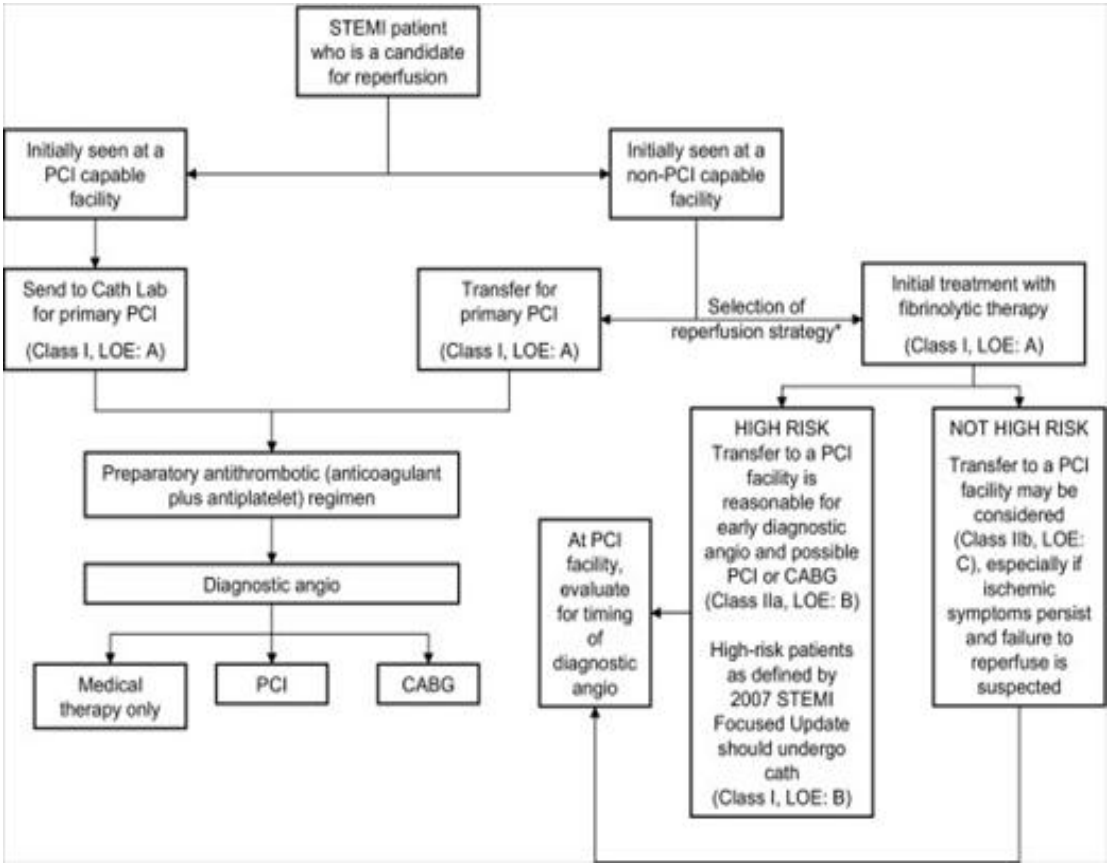
PRIMARY PCI

Effective reperfusion following ST elevation MI can be done by thrombolysis or primary percutaneous intervention,without precedent thrombolysis[38].It is also known as primary angioplasty. 95 % of patients treated with primary PCI obtain complete perfusion ,whereas only 50 to 60 % of patients have complete reperfusion when treated by thrombolysis[39] . Primary PCI has the advantage of lower risk of stroke and angiography, quickly defines coronary vessels anatomy.

RESCUE PCI

Emergency PCI done in a patient with failed thrombolysis is called rescue PCI.Success of this technique in patients with moderate and large infarct size has been shown in terms of good LV function and outcomes[40].

FIGURE:



FACILITATED PCI

As the name indicates facilitated PCI refers to immediate pharmacotherapy followed by mechanical reperfusion.It leads to better antegrade blood flow restoration in IRA(Infarct Related Artery)[41].Bleeding manifestations were increased significantly in patients with facilitated PCI.

EARLY PCI

Primary percutaneous coronary intervention (PCI) is the preferred treatment for patients with STEMI[42]. But only few patients can receive it within recommended by the guideline i.e 90 min. Early routine PCI after thrombolysis in STEMI patients combined lytic therapy and angioplasty, which provides complete,rapid and sustained reperfusion for ST elevation MI patients[43].

DELAYED PCI

PCI done after 12 hours to 3 months after thrombolysis provides improved LV function,provision of coronary collaterals and electrical stability is increased[44].

COMPLICATIONS OF ACUTE CORONARY SYNDROMES

Most frequent complications associated are,

-Arrythmias and conduction disturbances

-Mechanical complications

-Pump failure

A) ARRYTHMIAS AND CONDUCTION DISTURBANCES

EARLY ARRYTHMIAS:

Ventricular arrhythmias-

Ventricular fibrillation/tachycardia occurring early after ST elevation MI is associated with increased mortality in-hospital,but not associated with long term mortality.Early predictive marker of VF/VT are neither nonsustained VT nor accelerated idioventricular rhythm[45].Ventricular ectopics are common in ST elevation MI,but their predictive value for VT is undetermined.

Supraventricular arrhythmias-

10 to 20% of ST elevation MI is complicated by atrial fibrillation.It occurs more commonly in older age patients,severe LV failure and heart failure[46].It is associated with increased incidence of stroke and in-hospital mortality.

LATE VENTRICULAR ARRYTHMIAS:

Ventricular arrhythmias occurring within first 24 to 48 hours have a low predictive value for occurrence of recurrent arrhythmias[47]. Arrythmias occurring later have a propensity to recur,in contrast.

CONDUCTION DISTURBANCES

Most common disturbance is sinus bradycardia seen in about 9 to 25%,especially found in inferior wall myocardial infarction. This is treated with injection atropine or temporary pacing if atropine fails[48].

Persistent bundle branch blocks are seen in 5.3% of cases.AV blocks occurs in 7% of cases.Patients with AV block tend to have an extensive region of infarction.So they have a high in-hospital mortality.

B) CARDIOGENIC SHOCK

It can defined as the organ dysfunction due to hypoperfusion due to cardiac dysfunction .Due to inadequate cardiac output there is tissue hypoxia ,fluid overload and heart by itself becomes susceptible to hypoperfusion[49].Progresive tissue hypoperfusion worsens ongoing ischemic process and contribute further in detoriation of myocardial function.

Criteria for defining cardiogenic shock

-systolic BP <80 mm of Hg

-persistent hypotension(atleast 30 min)

-cardiac index <1.8L/m2/min

-oliguria,confusion,cold extremities

-pulmonary capillary wedge pressure >18mm of Hg[50]

CAUSES FOR CARDIOGENIC SHOCK IN ACUTE MI

1)Large infarction size (left main coronary artery,proximal LAD related artery)

2)Small infarct over pre existing severe LV dysfunction

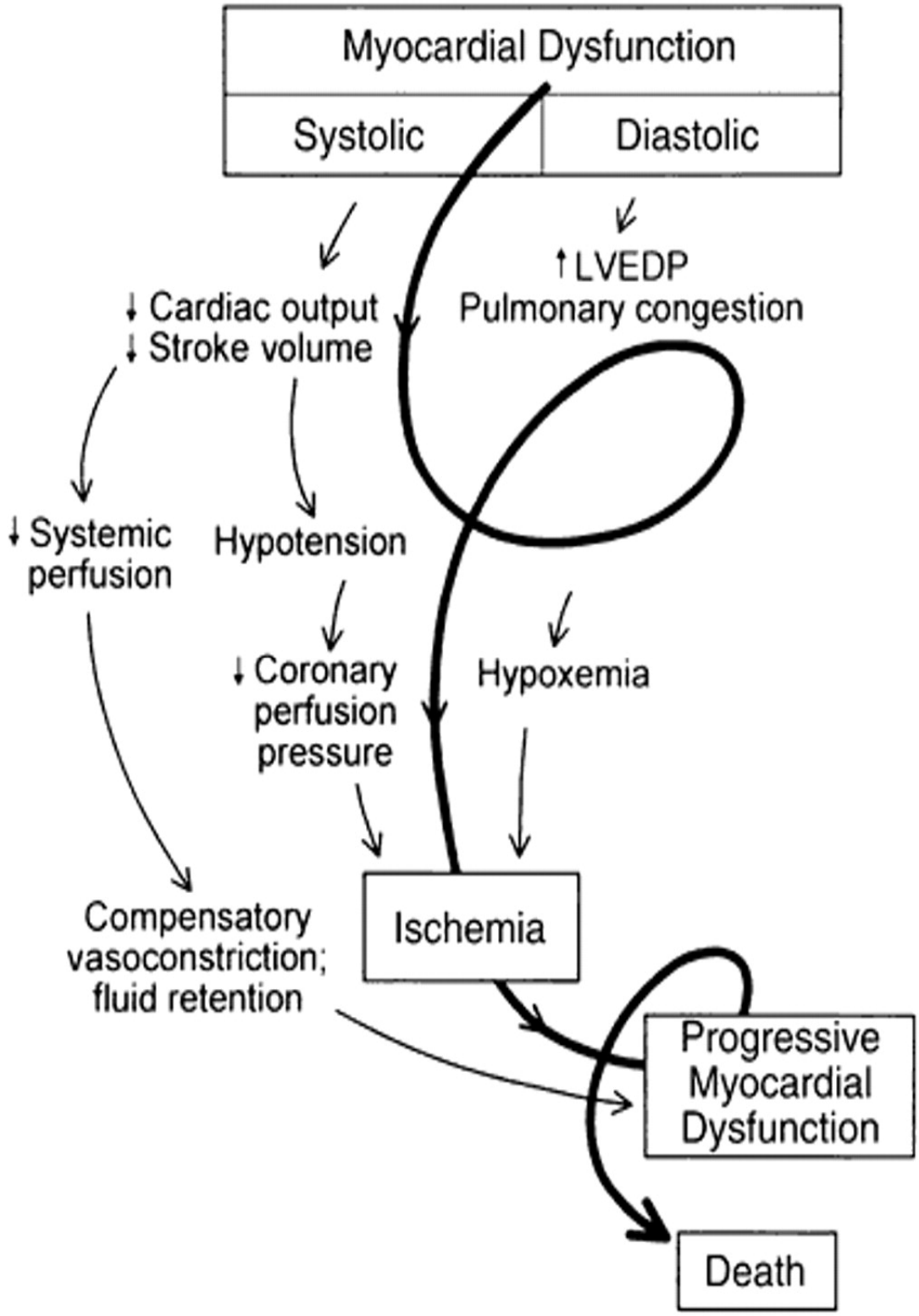
3)Acute mitral regurgitation

4)Ventricular septal rupture

5)Free wall rupture

6)Pericadialtamponade

7)Right ventricular infarct[51].


Myocardial Dysfunction
Systolic
Diastolic
↑ LVEDP
Pulmonary congestion
↓ Cardiac output
↓ Stroke volume
↓ Systemic perfusion
Hypotension
↓ Coronary perfusion pressure
Hypoxemia
Compensatory vasoconstriction; fluid retention
Ischemia
Progressive Myocardial Dysfunction
Death

INVESTIGATIONS

ECG

ST elevation or depression are significant.ST elevations are useful in locating the culprit artery.LBBB denotes extensive anterior wall involvement.Low voltage complexes indicate pericardial effusion,massive infarction.Atrial fibrillation (AF) is the most common tachyarrythmia.

CHEST X RAY

Enlarged cardiac shadow indicates previous structural heart disease. Normal sized heart shadow indicates newer onset cardiac pathology. Pulmonary congestion is present often seen pulmonary edema. Flask shaped heart is seen in pericardial effusion[52].

ECHOCARDIOGRAPHY

It is a valuable test in establishing cardiac cause for shock.It can identify LV or RV dysfunctions,valvular lesions,pericardial tamponade,papillary muscle dysfunction,ventricular septal rupture.TEE has an advantage over TTE[53].

PULMONARY CAPILLARY WEDGE PRESSURE

It has a definite role in most cardiogenic shock cases.It assess the filling pressure and cardiac output.It helps to differentiate between cardiogenic and non cardiogenic pulmonary edema.

MANAGEMENT

INOTROPES

Levosimendan is a new calcium channel sensitizer which improves myocardial contractility,without increasing myocardial oxygen demand.It induces coronary and peripheral vasodilatation.Dopamine infusion is started at the rate of 5 to 10 microgram/kg/min.

INTRA AORTIC BALLOON PUMP

Intra aortic balloon pump (IABP) counterpulsation is in use for the past 30 years.It is introduced along the common femoral artery.The balloon is inflated with helium.It reduces the LV afterload ,in turn decreases the myocardial oxygen supply mismatch[54].It also increases the coronary blood flow during diastole.

Complications include limb ischemia ,hypotension, bleeding, infection and cholesterol embolization.

PERCUTANEOUS CARDIOPULMONARY SUPPORT

Whatever the underlying cardiac rhythm and cardiac function, percutaneous cardiopulmonary support provides cardiac support during PCI. This technique involves insertion of large bore cannula into the femoral artery and vein.Blood is collected from right atrium and circulated via membrane oxygenator and a heat exchanger and reinfused into arterial system via femoral artery.

IMPELLA 2.5 SYSTEM

Impella 2.5 system is a device placed across aortic valve.The device aspirates blood from left ventricular cavity and expels into the ascending aorta.

C) MECHANICAL COMPLICATONS

FREE WALL RUPTURE

It can be subacute or acute.When the free wall rupture is acute ,it is generally fatal.It is characterized by electromechanical dissociation and cardiovascular collapse.Clinical features are similar to reinfartion.Has chest pain and ST elevation in ECG.Signs of cardiac tamponade occurs.ECHO shows site of free wall rupture and hemopericardium(pericardial space is filled with clot).Urgent surgical repair is the main stay of treatment.

VENTRICULAR SEPTAL RUPTURE

It may occur on day one,most commonly from 3 rd to 5 thday.Most common in anterior wall MI.Symptoms include dyspnea and chest pain.There is pan systolic murmur which is loud and marked features of cardiogenic shock.ECHO is diagnostic and it shows left to right shunt across the interventricular septum[55].

Surgery is the best option.It comprises of debridement of necrosed area and reconstructed with prosthesis.But prognosis is very poor.Initial support can be given by intra aortic balloon counter pulsation.Nitroprusside is given for afterload reduction[56].

MITRAL REGURGITATION

13 to 45 % of patients with STEMI are found to have mitral regurgitation of mild to moderate severity.Severe mitral regurgitation in the setting of acute MI caused by papillary muscle dysfunction accounts for cardiogenic shock and mortality.Other mechanisms include a) left ventricular dilatation b)severe RWMA(regional wall motion abnormalities) c)papillary muscle dysfunction due to ischemia[57].

Inferior wall MI is most commonly associated with papillary muscle rupture.Large infarct is not required to produce papillary muscle rupture as that of free wall rupture and ventricular

septalrupture.Itpresents with acute severe dyspnea,pulmonary edema and cardiogenic shock[58].Unlike murmur of ventricular septal rupture the murmur of MR is soft .

Emergency bedside ECHO is the required for diagnosing. Pulmonary artery catheterization demonstrates large Y waves.

Treated by measures reducing the afterload like nitroprusside and IABP. Inotropes are frequently combined.Mitral valve replacement may be required[59].

D)RIGHT VENTRICULAR INFARCTION

Right ventricular MI with hemodynamically significance occurs in inferior wall or inferoposterior wall MI[60].

Clinical features include

-Elevated JVP

-Hypotension

-Pulsusparadoxus

-Kussmauls sign

-High grade AV block

-Tricuspid regurgitation

-Right sided s3 s4.

ECG shows ST elevation in V4R.It has 80% predictive value.ECHO shows degree of RV dysfunction and left ventricular inferior wall involvement.Pulmonary artery catheterization shows high right atrial pressure

TREATMENT

Fluid administration with hemodynamic monitoring.Central venous pressure is kept around 15mm Hg. Dopamine is the inotrope of choice as it increases the cardiac index and RV function.

Intervention like PCI with successful reperfusion of branches supplying right ventricle,have improved right ventricular ejection.Temporary pacing and IABP may be used[61].RV assist device is used none of the above methods help and patient remains in shock.

E) VENTRICULAR ANEURYSMS

Acute aneurysms may be severe enough to cause congestive cardiac failure and cardiogenic shock.It expands during systole.Chronic aneurysms are the one which are present more than 6 weeks.They usually don’t expand during systole.

Persistent ST elevation >4 wks points toward LV aneurysm.Chest xray may show localized bulge.ECHO is the investigation of choice. True aneurysm have wide neck which pseudo aneurysm doesn’t have.

If mural thrombus is detected anti coagulation is required for 3 to 6 months.Surgery is indicated if patients have refractory cardiac failure.

F) DYNAMIC LVOT OBSTRUCTION

Dynamic LVOT obstruction is an uncommon complication following an acute MI.Hyperkinesis of mid segments of LV and basal segment.LVOT obstruction results due to venturieffect[62].

ECHO demonstrates hyperkinesis,systolic anterior motion of anterior mitral leaflet and LVOT obstruction.Beta blockers are added gradually.Small boluses of normal saline may decrease obstruction.

G) DRESSLER'S SYNDROME

It occurs after 1 to 8 weeks after acute MI.Patients may present with fever,arthralgia,malaise,pleuritic chest pain,elevated ESR and leucocyte count.Autoimmune etiology has been postulated.ECHO shows pericardial effusion.It is treated by aspirin.NSAIDs and corticosteroids are avoided.Early pericarditis occurring within 1 to 4 days are reported in 10%.Chest pain increases by lying down and relieved by sitting up or leaning forward.ECG shows generalized ST elevation.ECHO shows pericardial effusion.Treatment is same as that of dresslers'ssyndrome[63].

SECONDARY PREVENTION AFTER ACUTE CORONARY SYNDROME

Primary prevention includes people with recognised risk factors and asymptomatic or preclinical stage of disease.Secondary prevention is targeted against people with established disease.The patient with an episode of acute MI are at very high risk of developing of another episode of ACS[64].

CONTROL OF RISK FACTORS

LIPIDS

High dose of statin should be started.fibrates should be included if triglycerides are high.

GOALS:

LDL <70mg/dl

HDL >40mg/dl for men

>50mg/dl for women

TG <150mg/dl

BLOOD PRESSURE

It is selected by considering cardiac status

GOAL: BP <140/85 mm of Hg.

DIABETES

Combination of dietary modification,physical activity,OHAs and

insulin.

GOAL:

HbA1C <7%

DIET

GOAL:

BMI <25

Waist circumference <40 inches for men

<35 inches for women

EXERCISE

Moderate intensity exercise.Atleast 30 minutes a day ,5 days a week.

SMOKING

With or without pharmacotherapy.Behaviour modification.

PHARMACOLOGIC MEASURES

ASPIRIN

Use of aspirin from a range of 75 to 325 mg daily found to have risk reduction of stroke,recurrent MI or cardiovascular death.It is recommended for each and every patient without contraindications.Aspirin desensitization should be done for patients with aspirin allergy.It should be started within 48 hours following CABG.For

patients after PCI, 1 month for bare metal stent,3 months for sirolimus eluting stent,6 months for paclitaxel eluting stent,aspirin is given in a higher dose of 325 mg/day[65].

CLOPIDOGREL

Clopidogrel is added to aspirin for patients after acute coronary syndrome and given for 12 months.Given for patients undergone PCI ,for atleast a month for bare metal stents and 12 months for drug eluting stents[66].

BETA BLOCKERS

Various randomized controlled trials have shown that beta blockers are beneficial in patients with MI ,depressed LV ejection fraction and heart failure.Beta blockers are continued indefinitely for patients with MI,left ventricular dysfunction,ACS and heart failure unless otherwise contraindicated.

RENIN ANGIOTENSIN ALDOSTERONE INHIBITORS

ACE inhibitors are prescribed for ST elevation MI patients to avoid cardiac remodelling.They are also recommended for post ACS patients with diabetes,hypertension and chronic renal failure.Post ACS patients should not be treated with combined ACE inhibitors and ARBs[66].

ANTICOAGULATION POST –ACS

Patients with left ventricular or left atrial thrombusshould be treated with warfarin,aspirin and clopidogrel.There is an increased risk of bleeding associated with use of this combination therapy.The INR is maintained between 2-3.It is also indicated in prosthetic valve post MI.

ANTIARRYTHMIC DEVICES

Studies have shown that selected patients post STEMI are shown to benefitted from implantable cardiacdevices.The recommendations for implantable cardiac devices are a) 40 days post MI and b) left ventricular EF 30 TO 35%.

Cardiac synchronization therapy for heart failure is indicated if a) Left ventricular EF < 35% b) QRS duration more than 0.12 seconds c) patient should be in sinus rhythm[(67)].

HEART FAILURE:

Heart failure is characterized by Breathlessness, fatiguability, crepitations and edema. There are two types of it.

1. Systolic failure (EF<40-50%)
2. Diastoic failure (EF>40-50%)

Some causes of systolic failure

1. Systemic hypertension
2. Coronary artery disease
3. Dilated cardiomyopathy

Some causes of diastolic failure

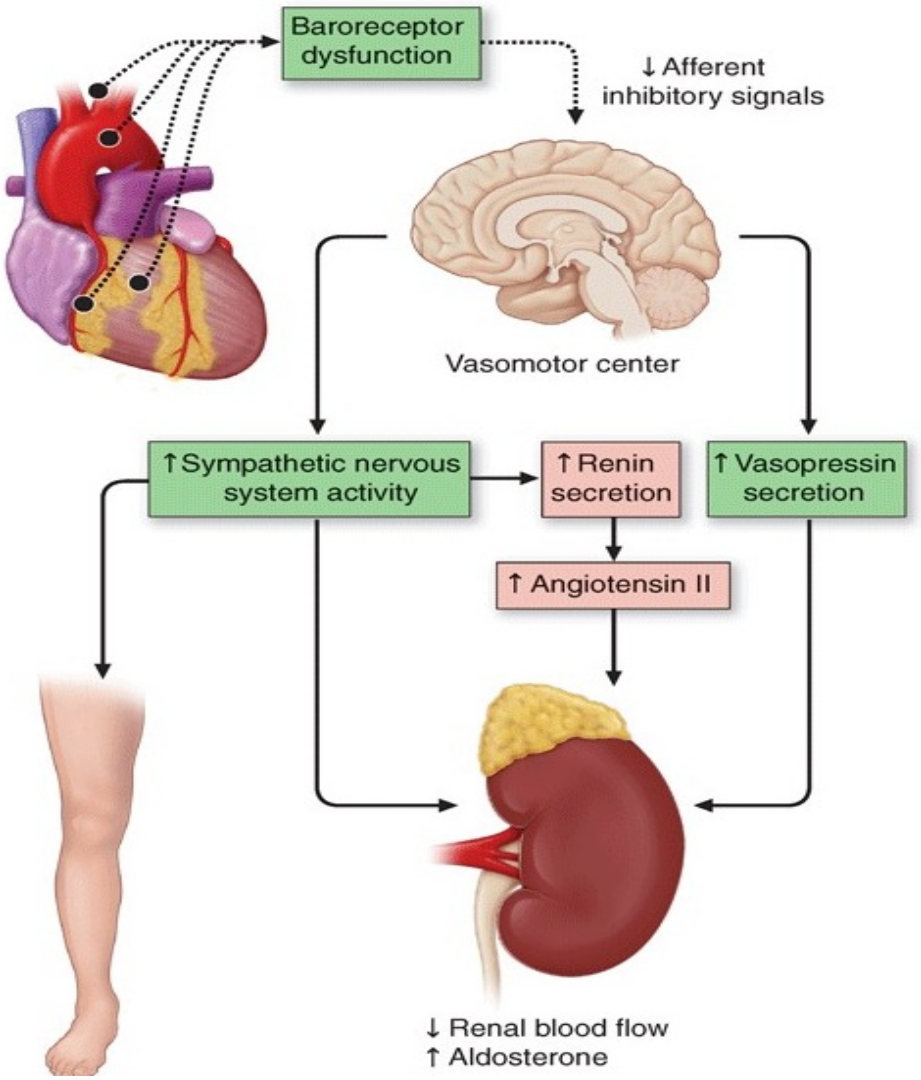
1. Restrictive cardiomyopathy
2. Old age[68].

NYHA classification of symptoms of heart failure:

NYHA class	**Features**
Class I	Routine activities do not cause undue fatigue, palpitations, dyspnea, or anginal pain.
Class II	Routine activities result in symptoms
Class III	Marked limitation of physical activity. They are comfortable at rest. Less than ordinary activity causes symptoms.
Class IV	Symptoms of heart failure or the anginal syndrome are present even at rest.

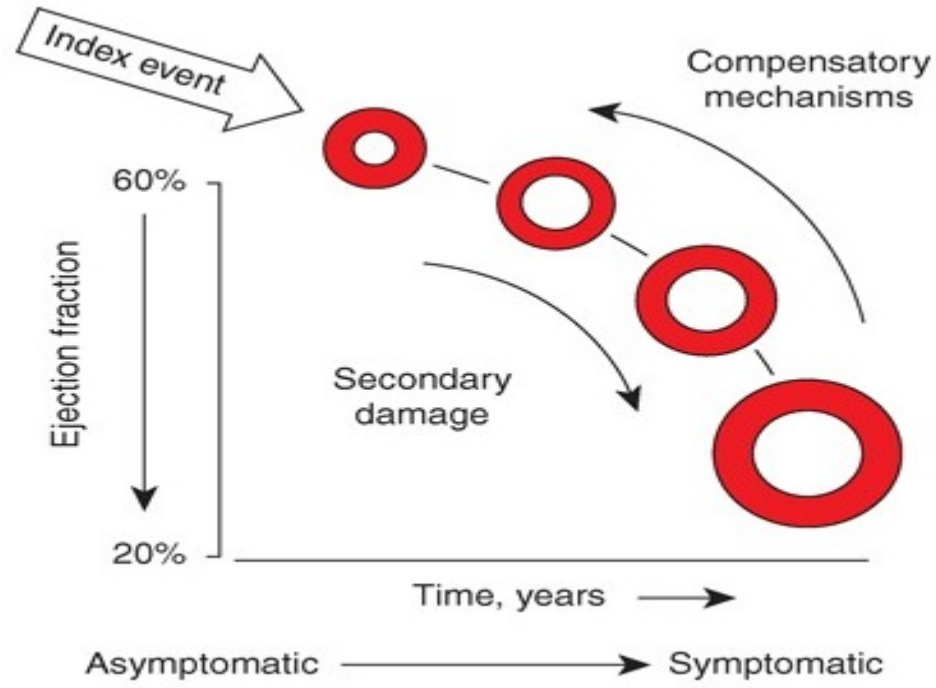
PATHOGENESIS:

FIGURE:



Increased Aldosterone will lead to increased sodium and water reabsorption[(69)].

FIGURE:



The various compensatory mechanisms include:

1. Increased Renin-Angiotensin-Aldosterone activity
2. Increased Sympathetic activity
3. Increased myocardial contractility
4. Increased vasodilatory molecules (ANP, BNP, PGE2 and PGI2)[70].

As a result of these stimuli, complex events occur at the cellular level leading to Ventricular Remodelling[71].

Those are

1. Myocyte hypertrophy
2. Myocyte loss via apoptosis, necrosis
3. Altered contractile properties
4. Altered myocyte metabolism
5. Reorganized extracellular matrix
6. Desensitization to beta adrenergic stimuli[72]

The biochemical stimuli for such changes are:

1. Norepinephrine
2. Angiotensin-2
3. Endothelin
4. TNF

All these microcellular level changes reflect on the anatomy of heart[73] as

1. Left ventricular wall thinning
2. Left ventricular dilation
3. Increased roundness of left ventricle

Clinical features- Symptoms:

1. Dyspnoea due to activation of pulmonary J receptors by intra-alveolar and interstitial accumulation of fluid[74].
2. Orthopnea.
3. Paroxysmal nocturnal dyspnoea
4. Cheyne-Stokes breathing
5. Anorexia , nausea , early satiety.
6. Right upper abdominal pain.
7. Confusion , disorientation.

Signs[75]:

1. Pedal edema
2. S3 gallop, S4
3. Cardiomegaly
4. Elevated jugular venous pulse
5. Fine crackles
6. Pleural effusion (usually bilateral , sometimes right sided)
7. Hepatomegaly
8. Ascites

Diagnosis:

Clinical features may suggest heart failure but 2D echocardiogram with doppler is essential for assessing the left ventricular function. Chest x-ray is essential for assessing the pulmonary vasculature and heart size.

ANP and N-terminal pro-BNP levels[75] are elevated in heart failure. But they are also elevated in old age, renal failure , obesity and pregnancy. So they act as adjuncts. Troponin levels will indicate myocardial cell necrosis[76].

ECG is needed to know the presence of any infarctions, rhythm abnormalities.

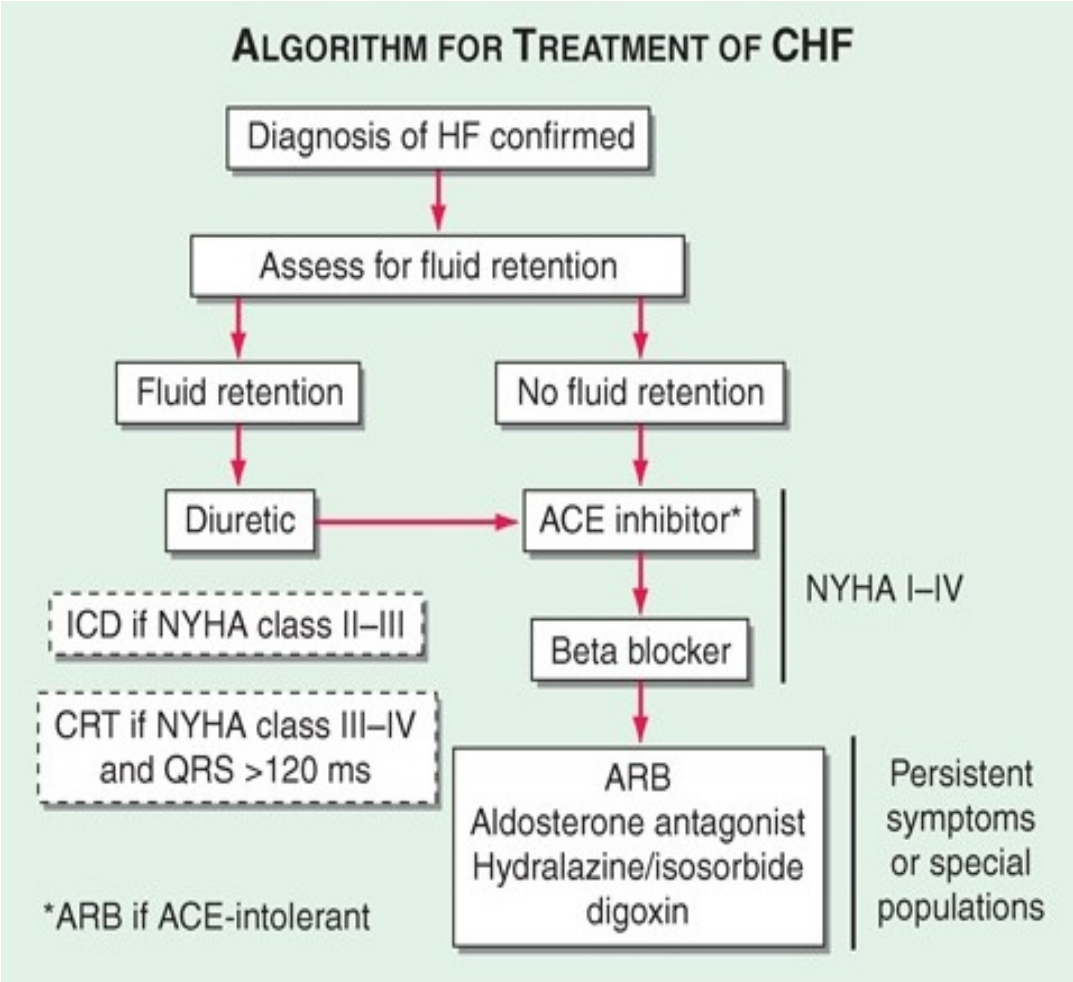
Routine investigations like CBC, urine routine examination, Blood urea, creatinine, Lipid profile, Thyroid profile should be taken.

Differential diagnosis:

1. Renal failure
2. Acute respiratory distress syndrome
3. Cirrhosis liver

MANAGEMENT OF CHF:

FIGURE:



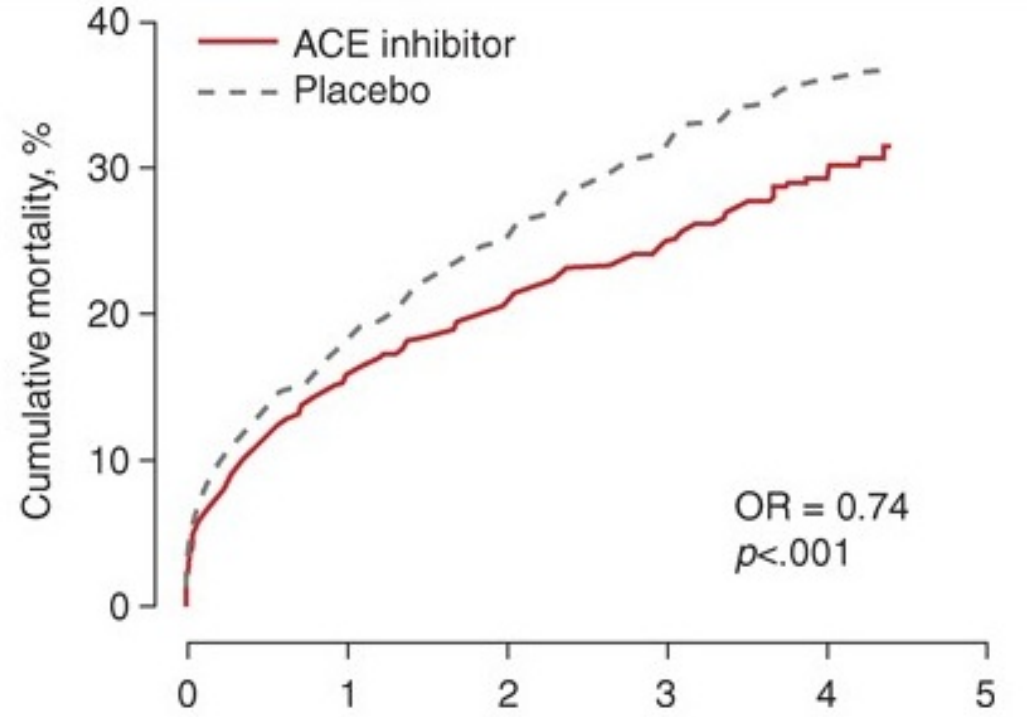
ICD- Implantable Cardiac Defibrillator

CRT-Cardiac Resynchronisation Therapy

ARB-Angiotensin Receptor Blocker

ACE- inhibitors in CCF therapy:

FIGURE:



ACE inhibitors play a main role in reducing the ventricular remodeling and thereby improving the survival. But the main adverse effects of ACE inhibitors are dry cough , angioedema and hyperkalemia. It is due to decreased degradation of bradykinin. In case of dry cough shifting to ARB's will avoid it since kinin degradation is not altered[(77)].

Diuretics :

They reduce the salt and water retention and thereby prevent the volume overload. Congestive features will be alleviated with the use of diuretics. Loop diuretics are preferred generally because of their efficacy.

The main adverse effect of loop diuretics is hypokalemia. It can be avoided by using potassium sparing diuretics like Spironolactone.

The use of aldosterone antagonist is preferred in case of NYHA 3 or 4,very poor EF(<30) and patient is already taking diuretics, ACE inhibitors and beta blockers[78].

DIGOXIN:

The use of digoxin in CHF is preferred in symptomatic patients with Atrial fibrillation[79].

CARDIAC RESYNCHRONISATION THERAPY:

It is indicated in symptomatic heart failure with Ejection Fraction less than 35% and duration of the QRS complex in ECG more than 120 msec. This device will stimulate the ventricles simultaneously and improve the ejection fraction[80].

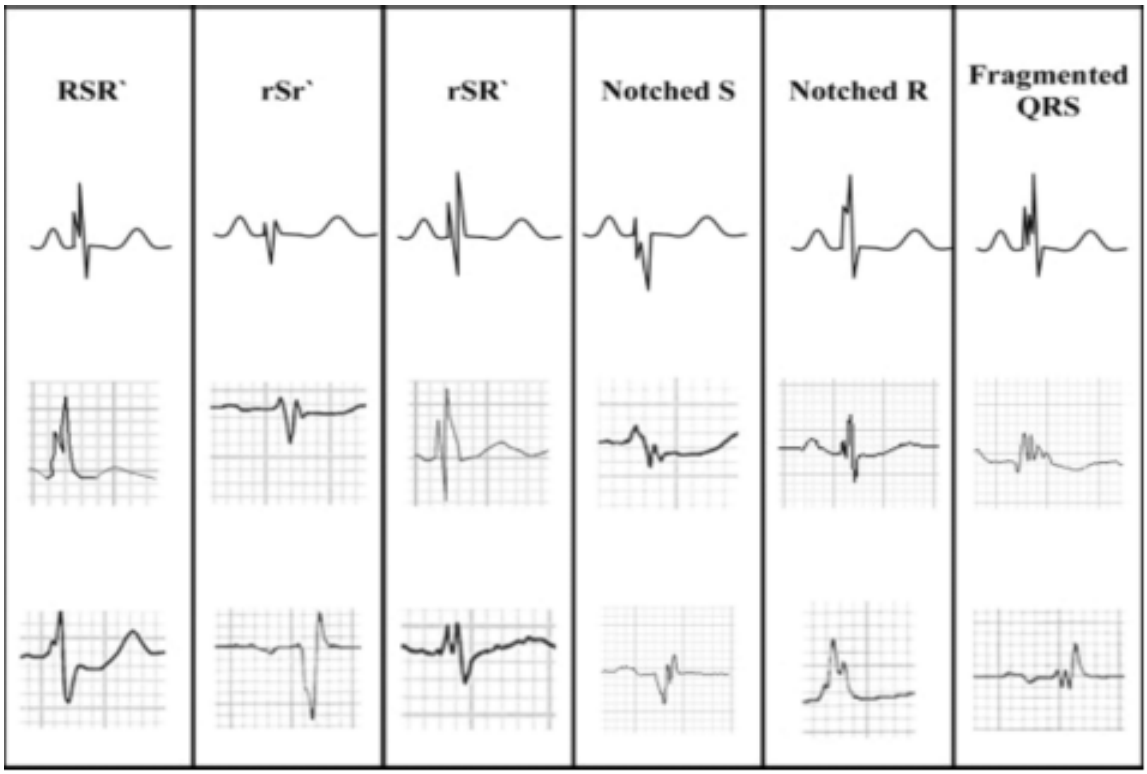
PRECIPITANTS OF ACUTE DECOMPENSATION OF CCF:

Anemia
Myocardial ischemia/infarction
Infection
Poor compliance
Alcohol consumption
Dietary indiscretion
Initiation of medications that worsen HF
Calcium antagonists (verapamil, diltiazem)
Beta blockers
NSAIDS
Antiarrhythmic agents [all class I agents, sotalol (class III)]
Anti-TNF antibodies
Arrhythmias
Pregnancy
Uncontrolled hypertension
Acute regurgitant lesions

There are various tell tale evidence of past myocardial injury in an resting 12 lead ECG,such as Q waves,wide QRS with bundle branch block and persistent ST elevation.Very little known entity is fragmented QRS complexes (fQRS).

An fQRS is defined by the presence of additional of R wave (R') or notching in the nadir of the S wave or the presence of >1 R' in two

contiguous leads[81].



This may be the only electrocardiographic marker of myocardial injury in non ST elevation MI and resolved Q wave.It may be a marker of left ventricular function.

Fragmentation in ECG is due to dysynchronous excitation of myofibres due to poorly interconnected muscle fibres;divided by high resistance intercellular connective tissue developed by myocardial scarring[82].Chamber dilatation and other gross structural abnormalities may show a similar pattern.

Fragmented QRS and left ventricular function

fQRS in an ECG independently predicts the left ventricular ejection fraction.This is a marker of high stress myocardial perfusion abnormalities.It was found in other studies that chamber dilatation grossly and decreased ejection fraction is truly reflected by fragmentation[83].

Prognosis with fragmented QRS

Fragmented QRS along with presence or absence of Q waves predict recurrent cardiac events and higher mortality.Though fQRS is not studied extensively is a reliable indicator of past ischemia of myocardium in the absence of Q wave[84].This suggests poorer prognosis because of the increased scar burden.

fQRS in non coronary artery diseases

Fragmentation is associated with other non coronary diseases like dilated cardiomyopathy,cardiac sarcoidosis,Brugada syndrome,acquired long QT syndrome[85].

Limitations of fQRS

To produce an fragmentation requires low pass filters settings(100 or 150 Hz)..It may be missed in filter setting of 40 or 60 Hz .Fragmented QRS is a non specific finding and should be interpreted only with evidence of CAD or myocardial scar[(86)].

Mustafa Cetin et al 2012 done a study on relationship between fQRS and systemic inflammation and found that fQRS was associated with increased CRP,left ventricular dysfunction and QRS duration.In addition ,fQRS also related with increased risk of cardiac risk with stable CAD patients.

V.M. Alla et al done a study on relationship between prognosis of patients with non ischemic cardiomyopathy and presence offQRS in their ECGs.It was found that the patients with narrow QRS and non ischemic cardiomyopathy the presence offQRS in ECG doesn't predict recurrent admissions for heart failure and all cause mortality.

Luc Lorgis, MD, PhD et al done a study on patients with acute myocardial infarction with presence of fQRS and its prognosticative value.He found that the there was a decreased survival rate in patients

with persistent fQRS and also recurrent myocardial infarction in patients with transient fQRS.

ErsinYıldırım et al in 2013 done a study in Acute STEMI Patients on the the presence of fQRS derivations and the number of fQRS derivations is associated with increasing size of infarction.

AIM OF THE STUDY:

1) To study the association between fQRS complexes in ECG and Left Ventricular Ejection Fraction and

2) To assess the usefulness of fQRS in determining the possibility of occurrence of adverse cardiac events (Ventricular tachycardia/fibrillation and sudden cardiac death) in Acute ST-elevation Myocardial Infarction.

BACKGROUND

SELECTION OF SUBJECTS:

Patients who were admitted in the intensive coronary care unit, Kilpauk Medical College Hospital.

Patients with fQRS were enrolled in cases.Patients without fQRS were enrolled in controls.

INCLUSION CRITERIA:

Patients presenting with acute ST elevation MI (STEMI)within 48 hoursof onset of symptoms.

EXCLUSION CRITERIA:

Patients with

- known Coronary artery disease
- known heart failure
- with typical RBBB/LBBB pattern in admission ECG.

MATERIALS AND METHODS

SETTING:

Kilpauk Medical College Hospital

STUDY DESIGN:

Case Control study

PERIOD OF STUDY:

6 months

SAMPLE SIZE:

60 subjects (30 cases+30 controls)

ETHICAL CLEARANCE**:**

Necessary ethical clearance was obtained from ethical committee, Kilpauk Medical College &Hospital, Chennai.

COLLABORATING DEPARTMENT:

Department of Cardiology, Kilpauk Medical College &Hospital, Chennai.

SAMPLE SIZE AND SAMPLING METHOD**:**

Consecutive patients of MI satisfying the inclusion criteria will be included. Assuming mean left ventricular ejection fraction in MI patients with fQRS and MI patients without fQRS as 41.66 % (SD: ±11.45) and 50.21% (SD:± 10.47) respectively, alpha error of 5% and 90% power, 30

MI patients with fQRS and 30 MI patients without fQRS will be required for the study (OpenEpi software).

Formula

$$n = \frac{2{S_p}^2\left[Z_{1-\alpha/2} + Z_{1-\beta}\right]^2}{\mu_d^2}$$

$$s_p^2 = \frac{s_1^2 + s_2^2}{2}$$

Where,

s_1^2 : Standard deviation in the first group

s_2^2 : Standard deviation in the second group

μ_d^2 : Mean difference between the samples

α : Significance level

$1-\beta$: Power

DATA COLLECTION**:**

The data of each patientswas collected in a specifically prepared proforma and includes relevant medical history, ECG findings on Admission and serial ECGs, and ejection fraction assessed by Echocardiogram within 48 hours of onset of symptoms.

STATISTICAL METHODS:

Data were entered in Microsoft Excel spreadsheet and analysed in SPSS software. Continuous variables like age and ejection fraction were expressed as mean (Standard Deviation). Association between fQRS and Ejection fraction was tested by comparing ejection fraction in Acute MI

patients having fQRS(cases) with that of Acute MI patients not having fQRS(controls),by Univariate analysis , done with paired t test and Pearson product moment correlation coefficient. A chi squared test was used to analyze the probability of differences in frequency distributions between the groups and $p<0.05$ was taken to be statistically significant in all calculations.

Occurrence of adverse cardiac events(ventricular tachycardia/ventricular fibrillation,sudden cardiac death) following Acute MI among the two groups will be expressed as percentages.

DATA ANALYSIS

The results of the study are shown in tables as below. The baseline characteristics observed are as follows,

Number of cases studied are-60.

SEX DISTRIBUTION

			GROUP		TOTAL
			CONTROL	CASES	
SEX	MALE	COUNT	23	22	45
		% WITHIN SEX	51.1%	48.9%	100.0%
		% WITHIN GROUP	76.7%	73.3%	75.0%
	FEMALE	COUNT	7	8	15
		% WITHIN SEX	46.7%	53.3%	100.0%
		% WITHIN GROUP	23.3%	26.7%	25.0%
TOTAL		COUNT	30	30	60

Table 1

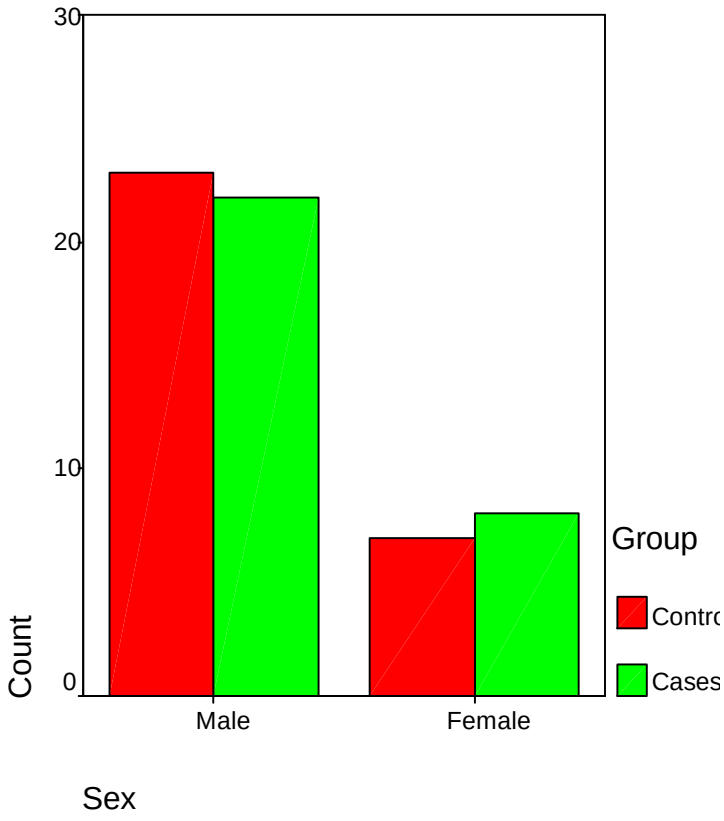


Fig 1

In this study the total no of males contribute 75% .females 25%. In cases males are higher 22%,females 8%. In controls females are 7%, males 23%. The P value is 0.766.So there is no significant difference in sex group in cases and controls.

DM GROUP

		GROUP		Total
		CASES	CONTROLS	
DM	Count	19	20	39
	% of Total	63.3%	66.7%	65%
Non-DM	Count	11	10	21
	% of Total	36.7%	33.3%	35%

Table 2

The diabetic patients in this study group is 65 %.In cases 63.3% and in controls 66.7%.The p value is 0.787.So the difference in diabetes population between cases and control are not significant.

The above finding is shown in the following graph

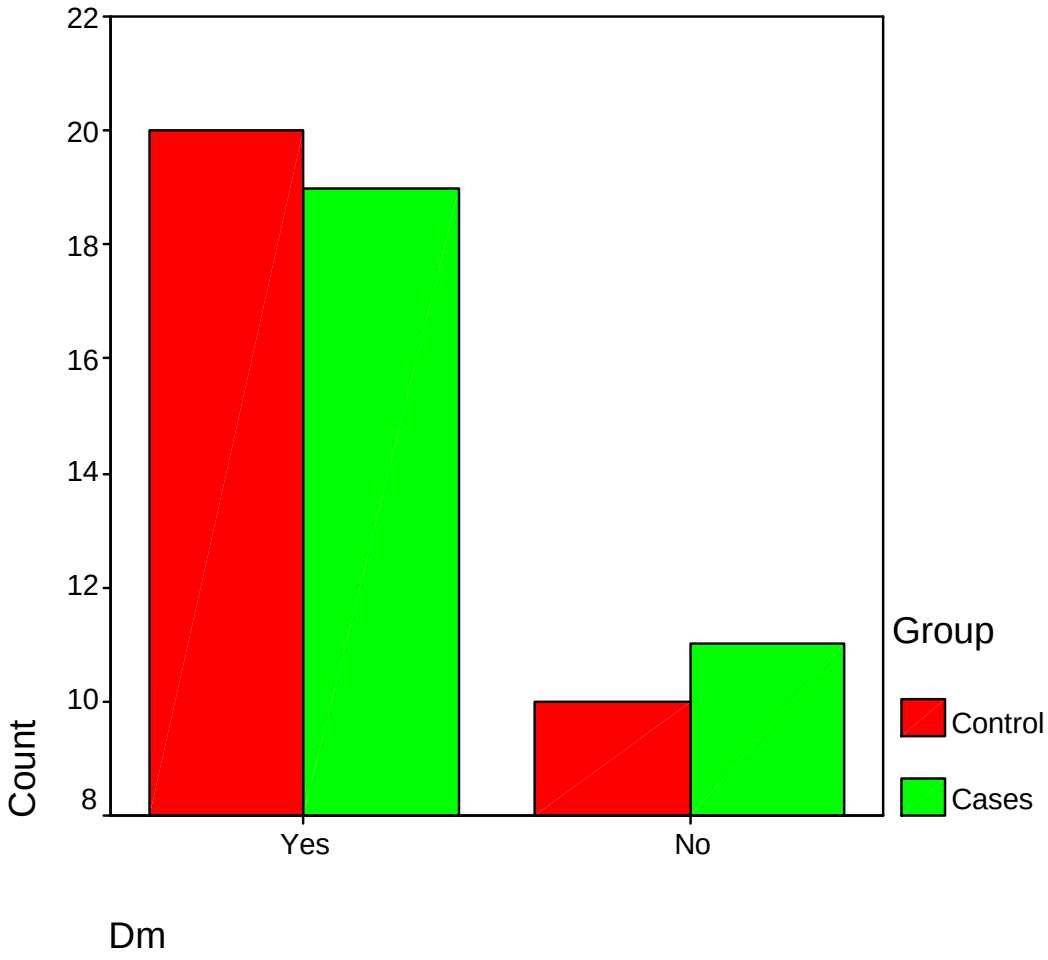


Fig 2

HYPERTENSION GROUP

In this study hypertensive population is 71.7%.Percentage of SHT in cases 66.7%.Percentage of SHT in controls 76.7%.The p value is 0.390.So there is no significant difference between two groups.The above finding is shown in the following table

			GROUP		Total
			CASES	CONTROLS	
	SHT	Count	20	23	43
		% of Total	66.7%	76.7%	71.7%
	Non-SHT	Count	10	7	17
		% of Total	33.3%	23.3%	28.3%

Table 3

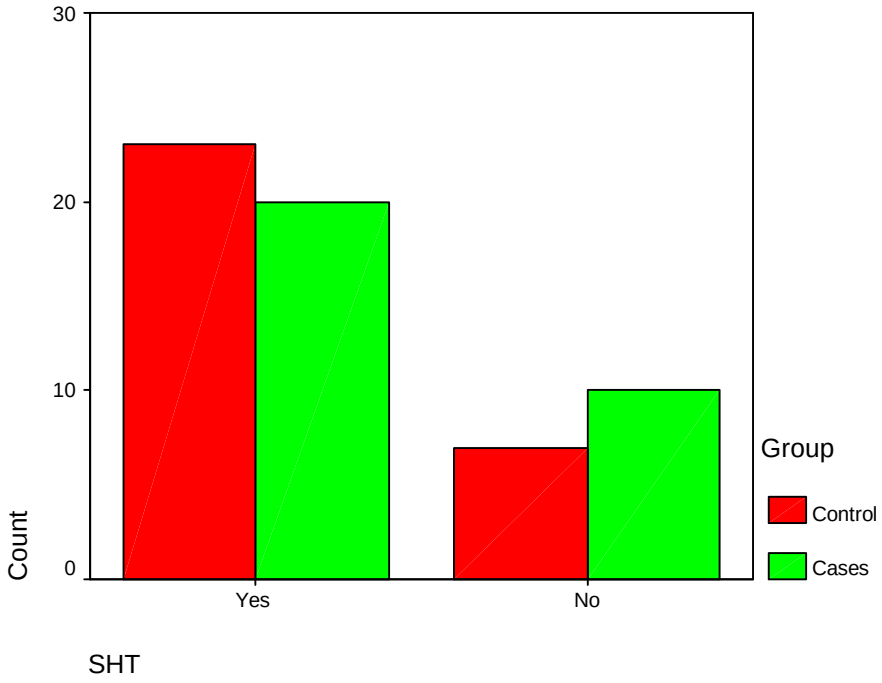
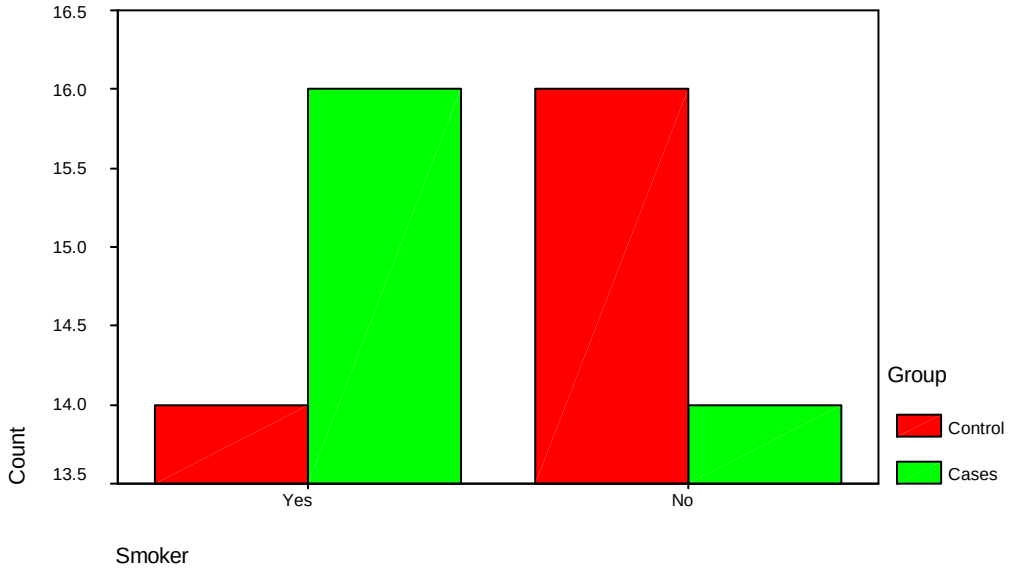


Fig 3

SMOKING GROUP



			GROUP		Total
			CASES	CONTROLS	
	SMOKERS	Count	16	14	30
		% of Total	53.3%	46.7%	50%
	Non-SMOKERS	Count	14	16	30
		% of Total	53.3%	46.7%	50%

Table 4

In this study smoking population is 50%.Percentage of smokers in cases 50%.Percentage of SHT in controls 50%.The p value is 0.606.So there is no significant difference between two groups.The finding are shown in the following above table.

ALCOHOL GROUP

		GROUP		Total
		CASES	CONTROLS	
ALCOHOLIC	Count	16	15	31
	% of Total	53.3 %	50%	51.7%
Non ALCOHOLIC	Count	14	15	29
	% of Total	46.7%	50%	48.3%

Table 5

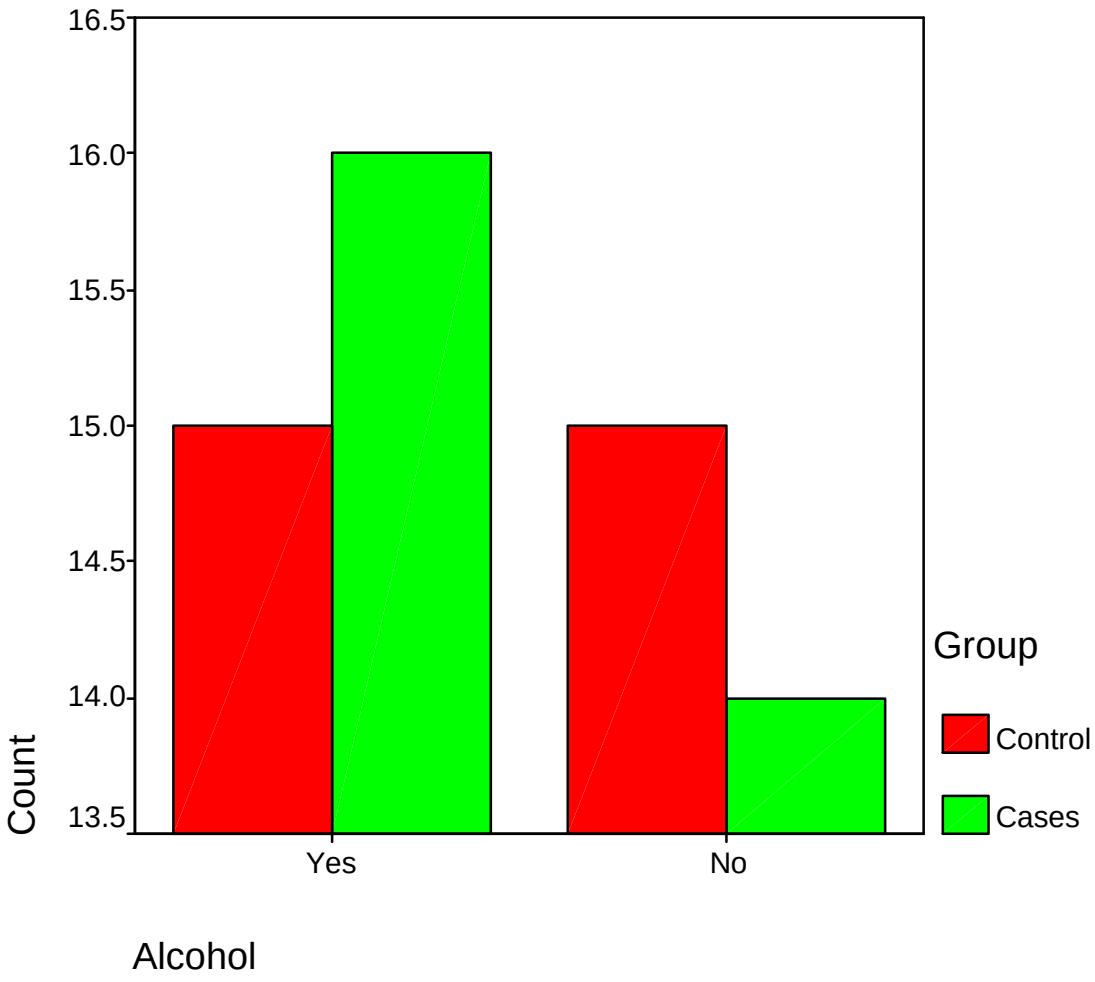


FIG 5

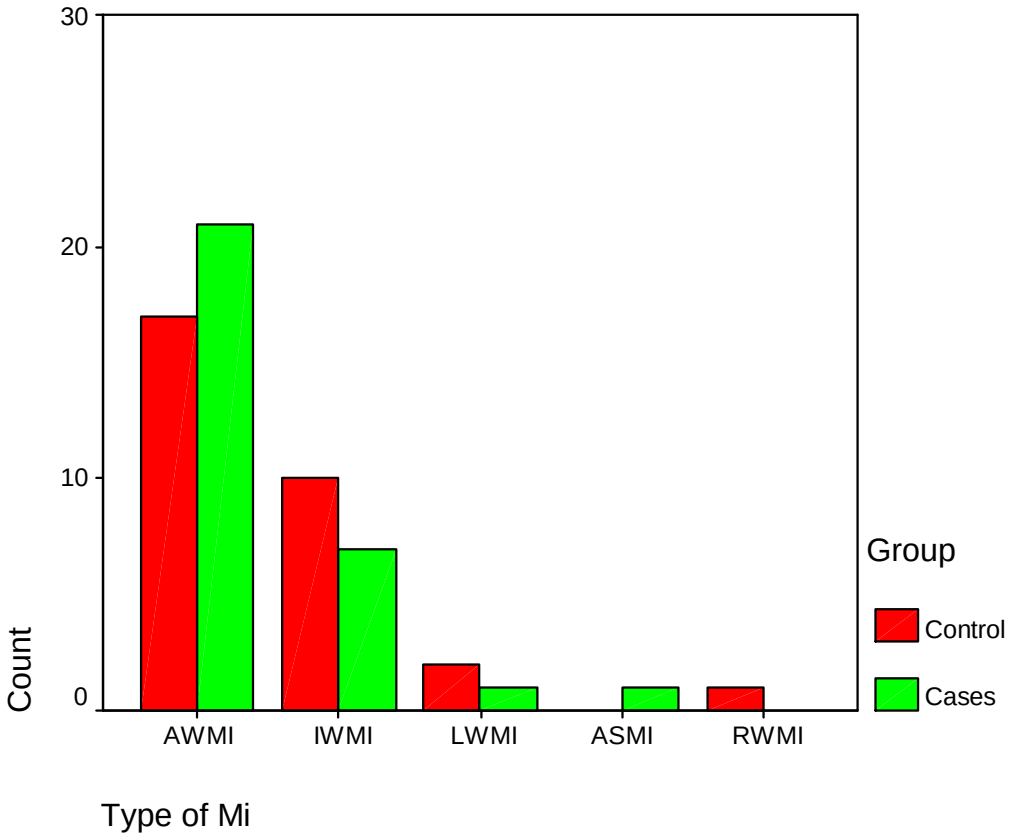
In this study alcoholic population is 51.7 %.Percentage of alcoholics in cases 53.3%.Percentage of alcoholics in controls 50%.The p value is 0.796.So there is no significant difference between two groups.The finding are shown in the following table 5.

DISTRIBUTION OF VARIOUS TYPE OF MI IN STUDY POPULATION

			Group		Total
			Control	Cases	
Type of MI	AWMI	Count	17	21	38
		% within Type of MI	44.7%	55.3%	100.0%
		% within Group	56.7%	70.0%	63.3%
	IWMI	Count	10	7	17
		% within Type of MI	58.8%	41.2%	100.0%
		% within Group	33.3%	23.3%	28.3%
	LWMI	Count	2	1	3
		% within Type of MI	66.7%	33.3%	100.0%
		% within Group	6.7%	3.3%	5.0%
	ASMI	Count	0	1	1
		% within Type of MI	.0%	100.0%	100.0%
		% within Group	.0%	3.3%	1.7%
	RWMI	Count	1	0	1
		% within Type of MI	100.0%	.0%	100.0%
		% within Group	3.3%	.0%	1.7%
Total		Count	30	30	60
		% within Type of MI	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

TABLE 6

FIG 6



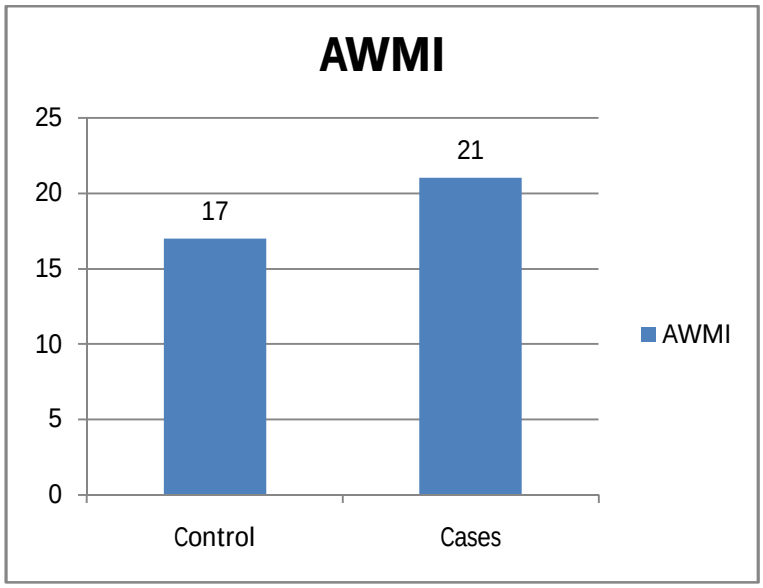
The above table shows the distribution of various type of myocardial infarction among the cases and controls.Among the cases anterior wall MI,inferior wall MI,lateral wall MI,anteroseptal MI and right ventricular wall MI comprises of 70.7% ,23.3% ,3.3% ,3.3% and 0.0% respectively.

Among the controls anterior wall MI,inferior wall MI,lateral wall MI,anteroseptal MI and right ventricular wall MI comprises of 56.7% ,33.3% ,6.7% ,0.0% and 3.3% respectively.

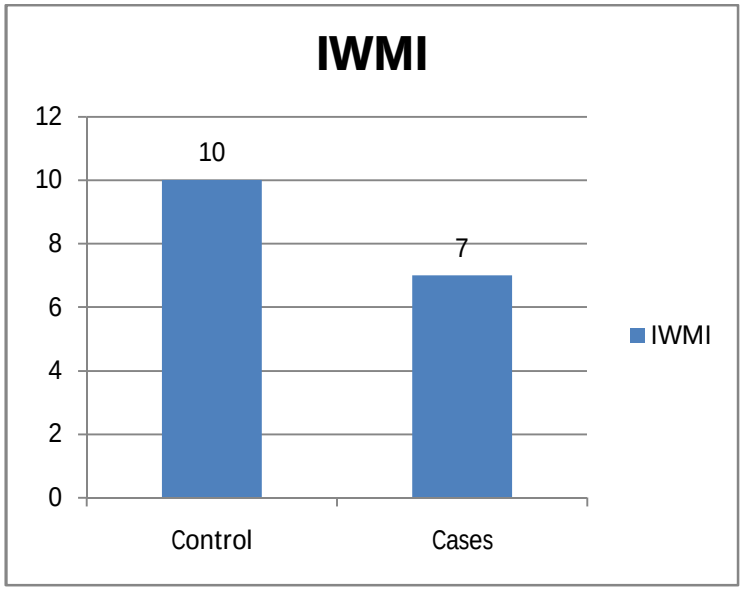
The p value is 0.512.Hence there is no statistical difference between the distribution of various type of myocardial infarction among the cases and controls.

Hence the occurrence of fragmented QRS in acute ST elevation MI is not dependent upon the type of the myocardial infarction.

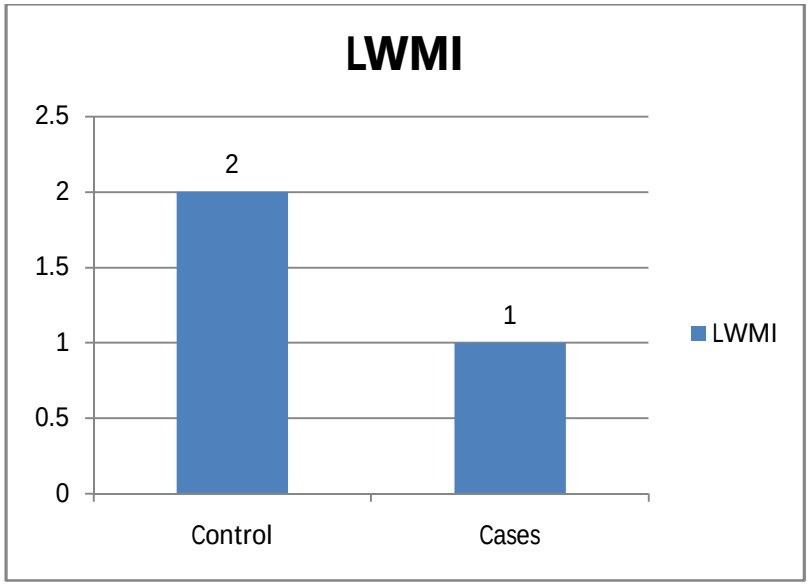
Type of MI	Control	Cases
AWMI	17	21



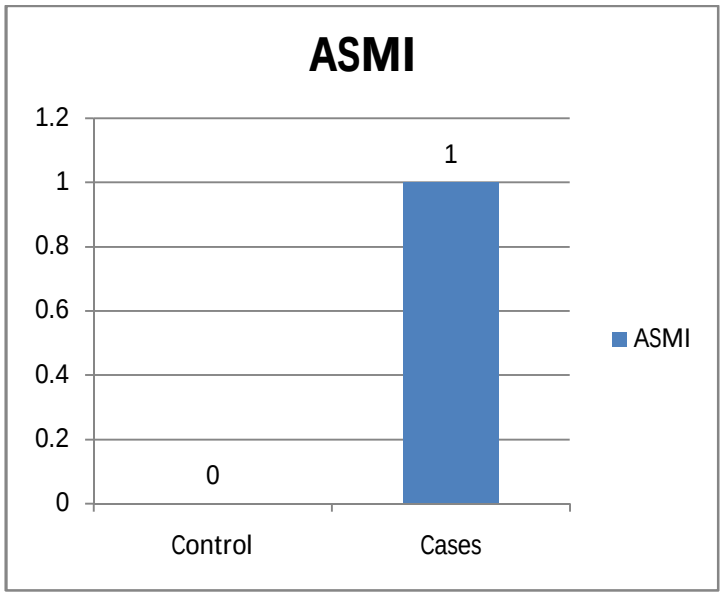
Type of MI	Control	Cases
IWMI	10	7



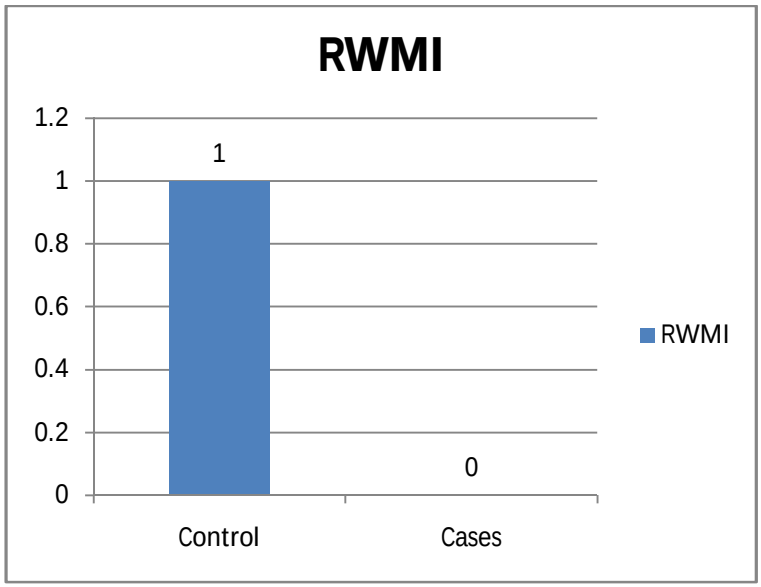
Type of MI	Control	Cases
LWMI	2	1



Type of MI	Control	Cases
ASMI	0	1



Type of MI	Control	Cases
RWMI	1	0



DISTRIBUTION OF FRAGEMENTED QRS

			Group		
			Control	Cases	Total
Fragmented QRS	Yes	Count	0	30	30
		% within Fragmented QRS	.0%	100.0%	100.0%
		% within Group	.0%	100.0%	50.0%
	No	Count	30	0	30
		% within Fragmented QRS	100.0%	.0%	100.0%
		% within Group	100.0%	.0%	50.0%
Total		Count	30	30	60
		% within Fragmented QRS	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

TABLE 7

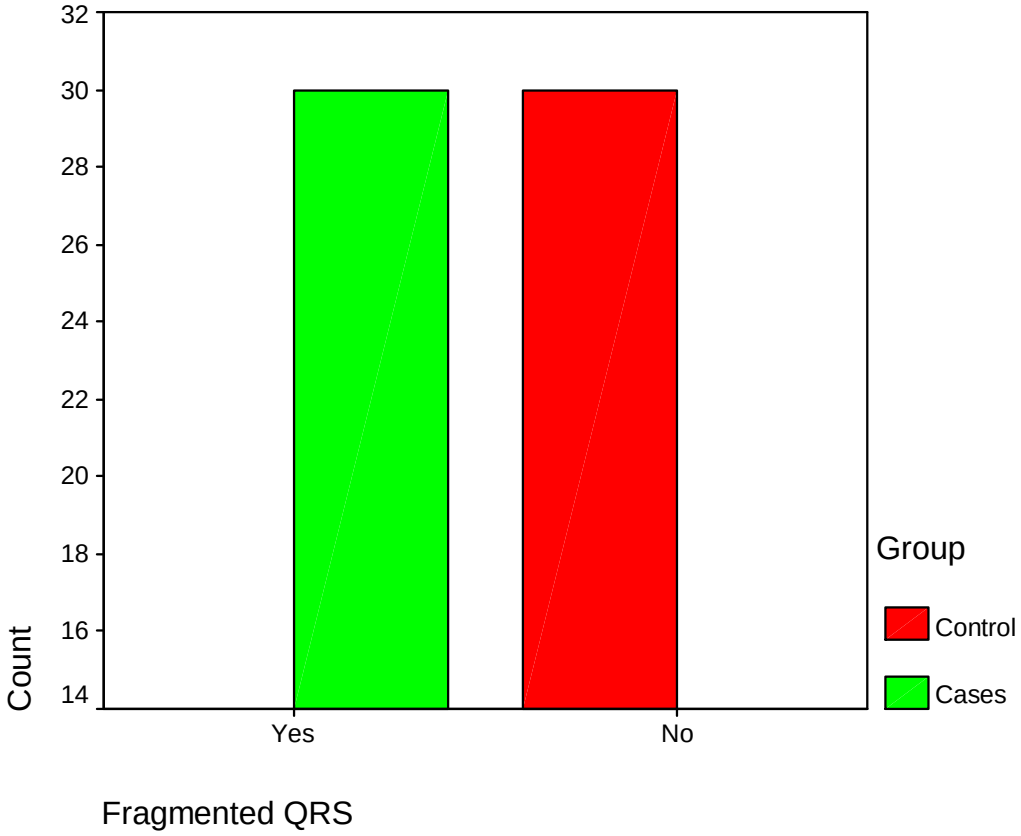


FIG 7

The p value is < 0.001**.Since this is a case control study the and the patients with fragmented QRS are enrolled under cases and patients without fragmented QRS are enrolled under controls there are equal number of cases and controls.

VENTRICULAR TACHYCARDIA/FIBRILLATION

DISTRIBUTION

			Group		
			Control	Cases	Total
Ventricular Tachycardia/Fibrillation	Yes	Count	1	2	3
		% within Ventricular Tachycardia/Fibrillation	33.3%	66.7%	100.0%
		% within Group	3.3%	6.7%	5.0%
	No	Count	29	28	57
		% within Ventricular Tachycardia/Fibrillation	50.9%	49.1%	100.0%
		% within Group	96.7%	93.3%	95.0%
Total		Count	30	30	60
		% within Ventricular Tachycardia/Fibrillation	50.0%	50.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

TABLE 8

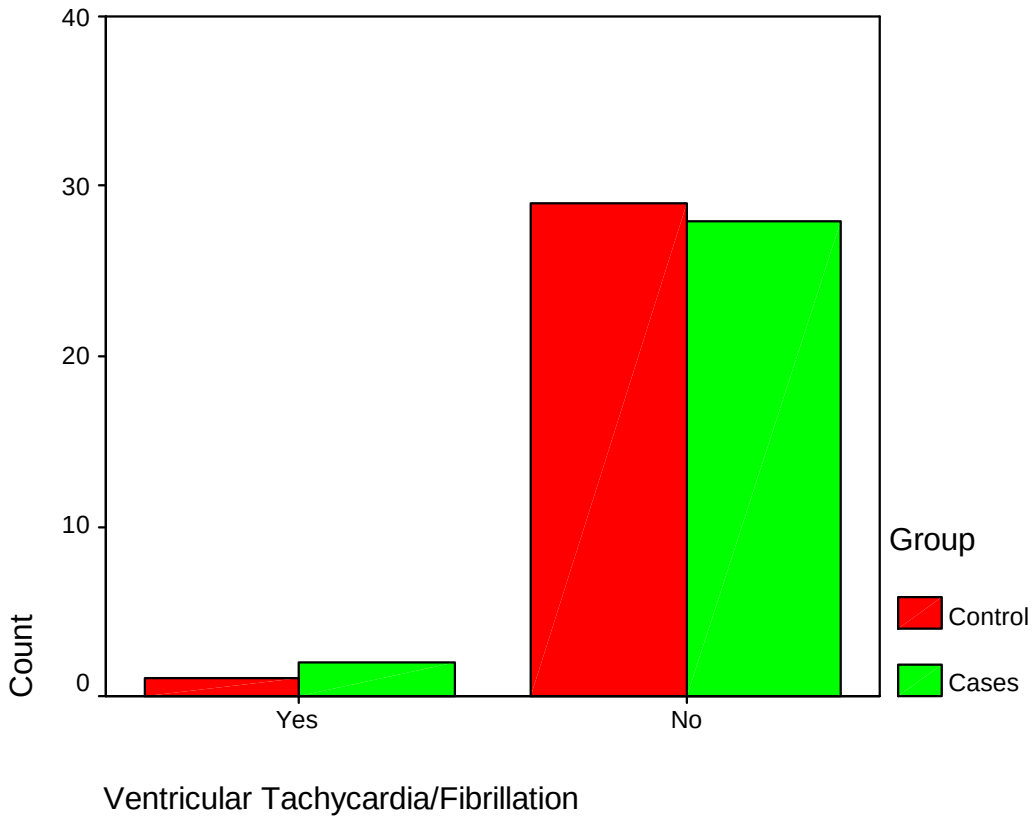


FIG 8

Among various studies conducted there was a significant statistical difference in occurrence of adverse cardiac events like ventricular tachycardia ,ventricular fibrillation or sudden cardiac death.But in this study p value is 0.554.Hence there is no statistical difference between two groups.

GROUP STATISTICS

AGE

	Group	N	Mean	Std. Deviation	Std. Error Mean
Age in years	Control	30	56.43	13.518	2.468
	Cases	30	54.43	11.578	2.114

TABLE 8

Age distribution among the cases and controls.Mean age among the cases 54.43.Mean age among the controls is 56.43.

SYSTOLIC BP AND DIASTOLIC BP

	Group	N	Mean	Std. Deviation	Std. Error Mean
SBP	Control	30	132.67	29.704	5.423
	Cases	30	133.67	23.265	4.248
DBP	Control	30	84.00	14.994	2.738
	Cases	30	86.33	12.994	2.372

TABLE 9

Systolic BP and diastolic BP among the cases are 133.67 and 86.33 respectively. Systolic BP and diastolic BP among the controls are 132.67 and 84.00 respectively.

DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	60	22	85	55.43	12.519
SBP	60	80	220	133.17	26.457
DBP	60	60	120	85.17	13.960
Ejection Fraction	60	24.65	70.11	47.5092	13.12034

TABLE 10

The above table 10 shows the minimum age recorded in the study is 22 and maximum is 85.The minimum and maximum systolic BP are 80 and 220 mm of Hg respectively.The minimum and maximum systolic BP are 60 and 120 mm of Hg respectively. The minimum and maximum ejection fraction are 24.65 and 70.11 % respectively.

RELATIONSHIP BETWEEN FRAGMENTED QRS AND LEFT VENTRICULAR EJECTION FRACTION

	Fragmented QRS	N	Mean	Std. Deviation	P value
Ejection Fraction	Yes	30	40.9510	11.18528	<0.001**
	No	30	54.0673	11.66733	

TABLE 11

Table 11 shows the relationship between the fragmented QRS and left ventricular ejection fraction.p value is < 0.001**. Hence there is an statistically difference between the cases and controls.

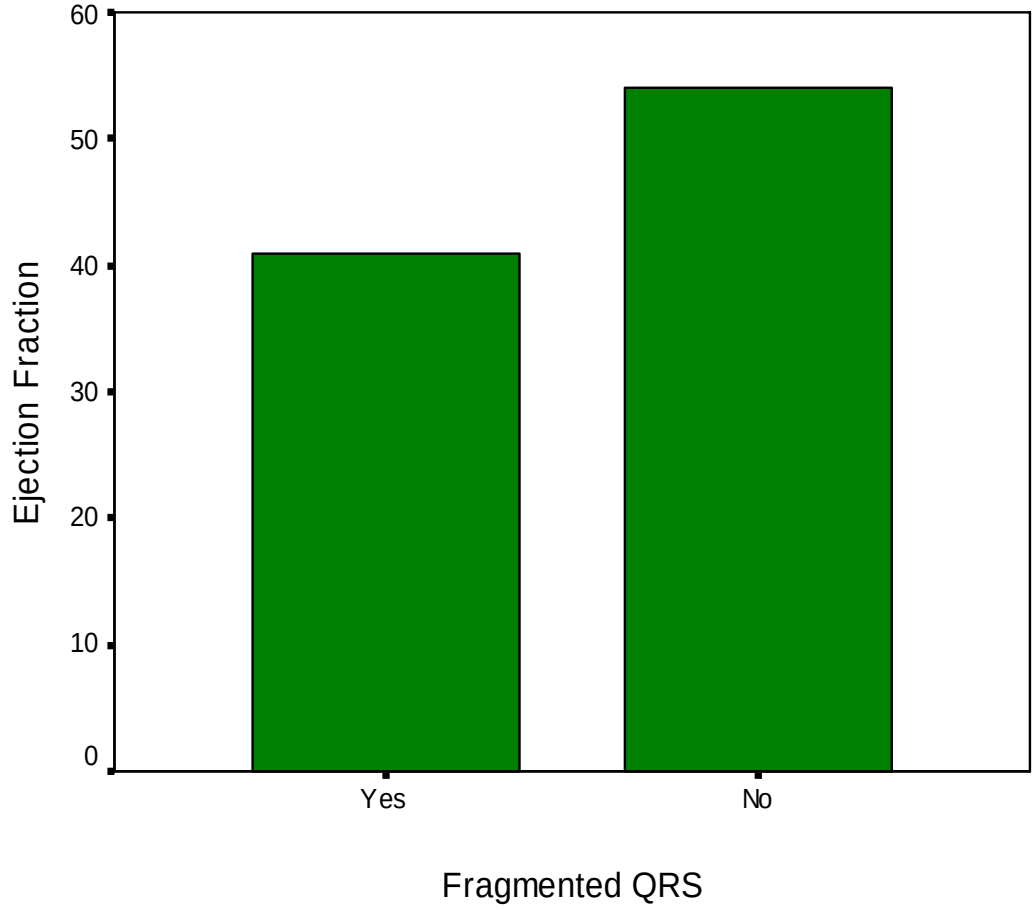


FIG 9

DISCUSSION

Ischemic heart disease is leading as the important cause of morbidity and mortality in India as well as in developing countries. Acute coronary syndrome (ST elevation MI,Non ST elevation MI,Unstable angina)is a medical emergency. There is a high prevalence of risk factors likediabetes mellitus, alcoholism smoking, hypertension, together with adverse life style changes, incidence of acute coronary syndrome is increasing day by day.

Prognosis in patients with acute coronary syndrome can be assessed by number of factors like associated heart failure signs,left ventricular ejection fraction, raised cardiac biomarkers.

In this case control study of relationship between fragmented QRS in an ECG and left ventricular ejection fraction patients presenting with Acute ST elevation MI consists of a group of 60 patients(cases 30+controls 30) who were admitted in intensive coronary care unit, Kilpauk Medical College &Hospital, Chennai.

A total of 30 cases were taken into the study.Cases are the patients with presence of fragmented QRS in the ECG .Controls were 30 in number.Controls are patients who were not having fragmented QRS in the ECG.

SEX DISTRIBUTION

In both cases and control group males were predominating .This may be attributed to life style activities like smoking and alcoholism.

EJECTION FRACTION AND FRAGMENTED QRS

Study showed that the mean ejection fraction of the cases group is 40.95 %.Mean ejection fraction fraction of the control group is 54.06 %.p value is < 0.001**.So there is significant statistical relationship between the presence of fragmented QRS and the ejection fraction.

VENTRICULAR TACHYCARDIA/FIBRILLATION AND FRAGMENTED QRS

Study showed that there is no statistical difference in occurrence of ventricular tachycardia/fibrillation among cases and controls.p value is 0.554.

Study done by Mr. Wang et al. in 2010 failed to show significant relationship for fQRSin detection of myocardial scarring in patients with coronary artery disease.

Since fQRS represents myocardial scarring, fQRS may be associated with ventricular tachyarrythmiaand heart failure

In 2012 Torigoe et al done a study and evaluated that the fragmented QRS by 12-lead ECG and showed that the number of the leads with fragmented QRS was a predictor for cardiac related death and recurrent hospitalization for cardiac failure in patients with prior myocardial infarction. Although the positive fragmented QRS is defined by the criteria included the presence of fQRS in two or more corresponding leads, study showed that the presence of fragmented QRS in three or more leads was the most useful for differentiating between the patients with and without risk for sudden cardiac death or repeated hospitalization for cardiac failure.

Presence of fragmented QRS in an 12 lead ECG signifies distortion of depolarization process and signal conduction within the ventricular musculature, and is related to myocardial scarring or myocardial fibrosis.

Previous papers published on patients with stable coronary artery disease or myocardial infarction have provided data consistent that fQRS is frequent, and is a reliable and simple tool to predict adverse cardiac events and all cause mortality.

CONCLUSION

1) There is an significant association between presence of fragmented QRS and the ejection fraction in the setting acute ST elevation myocardial infarction

2) There is no significant statistical relationship between presence of fragmented QRS and occurrence of ventricular tachycardia/fibrillation,in contrast to previous studies.This may be attributed the smaller sample size.

3)This study shows no statistically significant relationship between presence or absence of fragmented QRS and sex distribution, diabetes, hypertension and alcoholism.

4)There has been a retrospective study done which shows thatif the patient has a preexisting fQRS complex on the ECG and a implantable cardioverterdefibrillator (ICD), the device is more likely to discharge[87].Hence in the future, it may become a tool in the selection of appropriate candidates for ICD implantation.

LIMITATIONS OF THE STUDY

- Fragmented QRS in a 12 lead ECG requires an optimal and low pass filter setting of 100 or 150 Hz. Fragmentation may beeasily missed with using of a filter setting of 40 or 60 Hz.

- It should be kept in mind that fragmented QRS is not a specific finding and should only be interpreted only in the presence of appropriate clinical evidence of myocardial scarring as in coronary artery disease or primary electrical abnormalities such as Brugada syndrome.

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ABBREVIATIONS USED

ACS- ACUTE CORONARY SYNDROME

STEMI- ST ELEVATION MYOCARDIAL INFARCTION.

NSTEMI- NON ST ELEVATION MYOCARDIAL INFARCTION

UA- UNSTABLE ANGINA

SHT- SYSTEMIC HYPERTENSION

DM- DIABETES MELLITUS

LVD- LEFT VENTRICULAR DYSFUNCTION

AWMI- ANTERIOR WALL MYOCARDIAL INFARCTION

IWMI- INFERIOR WALL MYOCARDIAL INFARCTION

RVMI- RIGHT VENTRICULAR MYOCARDIAL INFARCTION

CPK-MB- CREATININE PHOSPHOKINASE MB

B-BLOCKER- BETA BLOCKER

CHD- CORONARY HEART DISEASE

ACE- ANGOTENSION CONVERTING ENZYME

PCI- PERCUTANEOUS CORONARY INTREVENTION

ECG- ELECTROCARDIOGRAM

HDL-HIGH DENSUTY LIPOPROTEIN

LDL- LOW DENSITY LIPOPROTEIN

SMC- SMOOTH MUSCLE CELL

UFH- UNFRACTIONATED HEPARIN

LMWH- LOW MOLECULAR WEIGHT HEPARIN

PROFORMA

NAME: **AGE/SEX:**
I.P.NO:

ADDRESS :

OCCUPATION :
RISK FACTORS

SYSTEMIC HYPERTENSION	**Y/N**
DIABETES MELLITUS	**Y/N**
SMOKING	**Y/N**
ALCOHOLISM	**Y/N**

DATE AND TIME OF ONSET OF SYMPTOMS :

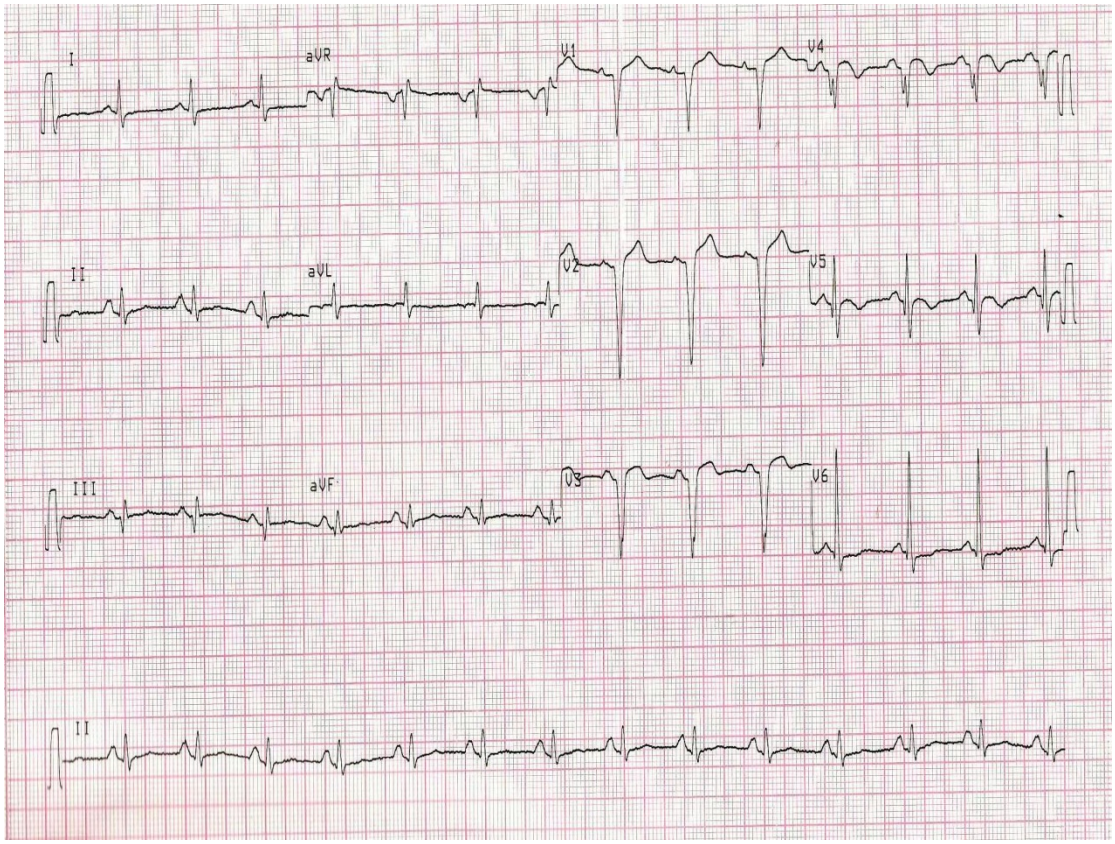
DATE AND TIME OF ADMISSION :

DATE OF DISCHARGE :

ELECTROCARDIOGRAPHIC (ECG) FINDINGS :

ECHOCARDIOGRAM FINDINGS :

EJECTION FRACTION :


I
aVR
V1
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II
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V2
V5
III
aVF
V3
V6
II

MASTER CHART-CASES

S.NO	NAME	AGE	SEX	DM	SHT	SMOKER	ALCOHOL	SYSTOLIC BP	DIASTOLIC BP	TYPE OF MI	FRAGMENTED QRS	VENTRICULAR TACHYCARDIA/ FIBRILLATION	EJECTION FRACTION
1	KADHAR NISHA	60	F	x	✓	x	x	140	90	AWMI	✓	x	46.58
2	JAGADEESAN	58	M	x	✓	x	✓	120	80	ASMI	✓	x	36.55
3	PANDIAN	65	M	✓	x	✓	✓	120	80	LWMI	✓	x	41.67
4	PALAMALAI	63	M	✓	✓	✓	x	150	90	AWMI	✓	x	55.55
5	GAJENDIRAN	54	M	✓	✓	✓	✓	140	80	AWMI	✓	x	53.16
6	NOOR MOHAMMED	66	M	x	✓	x	x	110	70	IWMI	✓	x	28.11
7	HARIDOSS	46	M	✓	x	x	✓	200	110	AWMI	✓	x	61.08
8	ANNAMALAI	63	F	x	x	x	x	140	100	AWMI	✓	x	42.87
9	KRISHNAN	65	M	✓	✓	✓	✓	130	90	IWMI	✓	x	32.95
10	ARASU	54	M	x	✓	✓	✓	90	70	IWMI	✓	x	28.65
11	VENKATESAN	55	M	✓	✓	✓	x	150	90	AWMI	✓	x	33.33
12	RAJENDRAN	70	M	✓	✓	x	x	130	100	IWMI	✓	x	65.08
13	VELU	22	M	x	x	✓	✓	110	70	AWMI	✓	x	50.67
14	NARENDER	46	M	✓	✓	x	✓	190	100	AWMI	✓	x	44.58
15	EGAMBARAM	55	M	x	✓	✓	x	120	80	AWMI	✓	✓	30.81
16	RANGANATHAN	64	M	✓	x	✓	✓	130	100	AWMI	✓	x	41.56
17	SASIKALA	45	F	✓	✓	x	x	140	90	AWMI	✓	x	28.06
18	RATTINAMAL	55	F	✓	x	x	x	120	70	AWMI	✓	x	40.28
19	KALYANI	52	F	✓	✓	x	x	13O	70	AWMI	✓	x	41.11
20	KAMALAKANNAN	30	M	x	x	✓	✓	120	80	AWMI	✓	x	46.67
21	BAKTHAVACHALAM	60	M	✓	✓	✓	✓	160	110	AWMI	✓	x	33.45
22	SHEIK MUSTHAFA	52	M	x	✓	x	x	110	70	AWMI	✓	x	30.88
23	NARASAMMA	65	F	✓	✓	x	x	110	90	AWMI	✓	x	26.58
24	BHASKAR	37	M	✓	x	✓	✓	140	80	AWMI	✓	✓	30.07
25	SURESH KUMAR	48	M	✓	x	✓	✓	130	80	IWMI	✓	x	29.97
26	SARADHA	60	F	✓	✓	x	x	150	110	AWMI	✓	x	56.76
27	IDUMBAN	65	M	x	✓	✓	✓	130	90	AWMI	✓	x	49.03
28	NARAYANAN	60	M	✓	✓	✓	✓	130	80	IWMI	✓	x	24.65
29	MEENATCHI	35	F	x	x	x	x	110	70	IWMI	✓	x	43.25
30	DHATCHINAMOORTHI	63	M	✓	✓	✓	✓	160	100	AWMI	✓	x	54.57

MASTER CHART-CONTROLS

S.NO	NAME	AGE	SEX	DM	SHT	SMOKER	ALCOHOL	SYSTOLIC BP	DIASTOLIC BP	TYPE OF MI	FRAGMENTED QRS	VENTRICULAR TACHYCARDIA/FIBRILLATION	EJECTION FRACTION
1	PADMANABAN	65	M	x	✓	x	x	160	100	AWMI	x	x	44.68
2	VINAYAGAMOORTHY	52	M	✓	✓	✓	✓	170	100	AWMI	x	x	55.9
3	PATTU	60	F	✓	x	x	x	100	60	IWMI	x	x	34.78
4	VISHWANATHAN	38	M	✓	x	✓	✓	90	60	IWMI	x	x	48.07
5	PARVATHY	85	F	✓	✓	x	x	120	80	IWMI	x	x	66.89
6	KAMATCHI	60	F	✓	✓	x	x	140	90	AWMI	x	x	70.11
7	GOPAL	60	M	x	✓	x	✓	150	90	IWMI	x	x	54.24
8	ARUNACHALAM	75	M	✓	✓	✓	✓	190	110	AWMI	x	x	49.94
9	PRAKASH	40	M	x	✓	✓	✓	150	100	AWMI	x	✓	45.07
10	SATHISH KUMAR	35	M	x	✓	✓	✓	120	80	AWMI	x	x	60.08
11	RAVI	50	M	x	✓	✓	x	130	80	LWMI	x	x	67.94
12	MURUGESAN	58	M	✓	✓	x	✓	140	90	AWMI	x	x	50.89
13	HARE RAM	48	M	✓	✓	x	x	130	80	AWMI	x	x	65.54
14	SUSEELA DEVI	64	F	✓	x	x	x	110	80	AWMI	x	x	57.09
15	RAJA	28	M	x	x	✓	✓	110	80	IWMI	x	x	66.68
16	PONNAIAH	60	M	✓	✓	✓	✓	80	60	AWMI	x	x	54.87
17	ASOKAN	59	M	✓	✓	✓	x	130	80	AWMI	x	x	40.65
18	AMINAMMAL	85	F	✓	✓	x	x	100	60	IWMI	x	x	44.65
19	PERIYAKARUPPAN	65	M	✓	✓	✓	x	150	90	AWMI	x	x	29.28
20	RAJAVELU	55	M	✓	✓	✓	✓	220	120	AWMI	x	x	60.16
21	GOPALAKRISHNAN	67	M	✓	✓	✓	x	130	90	AWMI	x	x	70.09
22	PANDIYAN	65	M	✓	x	x	x	120	80	LWMI	x	x	67.97
23	SARAVANAN	44	M	x	✓	x	✓	140	90	RWMI	x	x	43.32
24	INDRANI	49	F	✓	✓	x	x	110	70	IWMI	x	x	47.19
25	CHANDRASEKAR	43	M	x	✓	x	✓	100	70	IWMI	x	x	67.56
26	ANAND	58	M	x	x	✓	✓	130	80	IWMI	x	x	57.87
27	NARAYANAN	60	M	✓	✓	✓	✓	110	70	IWMI	x	x	65.76
28	NATARAJ	40	M	✓	x	x	✓	140	80	AWMI	x	x	42.65
29	JOHN CHELLADURAI	70	M	x	✓	x	x	150	100	AWMI	x	x	57.54
30	CHANDRA	55	F	✓	✓	x	x	160	100	AWMI	x	x	34.56

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.No.2212/ME-1/Ethics/2014 Dt:03.04.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study of relationship between left ventricular ejection fraction and fragmented QRS complexes on standard 12 – Lead electrocardiogram in acute ST – elevation myocardial infarction patients admitted in coronary care unit, Govt. Kilpauk Medical College Hospital" – For Project Work submitted by Dr.Sureshkumar.S, MD (GM), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

30/5/14
CHAIRMAN,
Ethical Committee
Govt.Kilpauk Medical College,Chennai